

WAR DEPARTMENT

ENGINEER FIELD MANUAL



TROOPS AND OPERATIONS

JANUARY 31, 1941

WAR DEPARTMENT,
WASHINGTON, *January 31, 1941.*

FM 5-5, Engineer Field Manual, Troops and Operations, is published for the information and guidance of all concerned.

[A. G. 062.11 (6-3-40).]

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DISTRIBUTION:

D 2, 7, 17 (3); B 2, 6, 7, 17 (3); R 5 (10); Bn 5 (5);
C 5 (10).

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TROOPS AND OPERATIONS

(This manual supersedes Engineer Field Manual, volume I, July 26, 1932.)

CHAPTER 1

GENERAL

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SECTION I

GENERAL

■ 1. MISSION.—The mission of engineers in war is to increase the combat effectiveness of the other arms through the execution of work to—

- a. Facilitate movement of our troops.
- b. Impede movement of the enemy.
- c. Provide for shelter and comfort of our troops.

■ 2. DUTIES (see AR 100-5).—*a. In theater of operations.*—

(1) Engineers facilitate movement of our troops by—

- (a) Removal or passage of obstacles.
- (b) Execution of demolitions and creation of obstacles for protection of flanks and rear against hostile raiding parties.
- (c) Provision of bridges or other means for crossing streams.
- (d) Construction and repair of roads.
- (e) Repair, extension, and operation of railroads.
- (f) Provision of port facilities for movement by water and maintenance and operation of inland waterways.
- (g) Construction of landing fields, base and protective facilities for movement by air and aerial operations.

(h) Production, reproduction, and distribution of maps and map substitutes to plan and guide the military effort as a whole.

(2) Engineers impede movement of the enemy by execution of demolitions and creation of obstacles; they increase combat power of other arms by furnishing technical assistance, tools, and engineer supplies for construction of defensive field works and camouflage, and by construction of works requiring special equipment and training; and finally they may be committed to combat.

(3) In addition to the primary missions given above, engineers contribute to the health and sustenance of troops by providing for their shelter and water supply, together with utilities and incidental installations (except signal communication).

b. In zone of the interior.—While engineers may be charged with duties in the zone of the interior similar to those in the theater of operations in connection with strictly military operations, they are charged with additional duties as follows:

(1) Providing defensive and protective works by—

(a) Joint participation in selection of sites.

(b) Preparation of plans and estimates.

(c) Construction and repair of fortifications, including installation and maintenance of such accessories therefor as searchlights, electric power and lighting systems, and fire-control systems.

(d) Developing camouflage technique and protective plans for the passive aerial defense of vital military and industrial installations.

(2) Preparing, reproducing, and distributing military maps, including—

(a) Cooperation with other Government and private mapping agencies.

(b) Reconnoitering and surveying for military purposes.

(3) Developing, procuring, storing, and issuing certain classes of supplies and equipment.

(4) Executing river and harbor improvements and such other civil works as may be assigned by law or by executive order.

■ 3. UNIT RELATIONS OF ENGINEERS.—*a. General.*—Engineer troops form part of the organization of all large tactical units down to include the division, and are also assigned as needed to certain headquarters in the communications zone and the zone of the interior. The term “unit” is used herein to denote those larger units of all arms of which the engineers form a component part such as division, corps, army, etc.

b. Unit engineer.—Within each such unit or headquarters engineer troops assigned thereto are commanded by an engineer officer termed the “unit engineer.”

(1) Unit engineers of the several territorial and tactical subdivisions have the following designations:

- (a) Theater of operations, chief engineer.
- (b) Communications zone, engineer, communications zone.
- (c) Section, communications zone, section engineer.
- (d) Army, army engineer.
- (e) Corps, corps engineer.
- (f) Division, division engineer.

(2) Engineer troops may also be assigned or attached to any troop unit, combat team, or other tactical grouping. Under such conditions the engineer officer commanding these engineer troops will perform the duties and have the responsibilities of a unit engineer (see par. 9) insofar as is necessary.

c. No statement of the duties of engineer troops should be construed as limiting the authority of a unit commander.

d. To derive the greatest benefit from engineers the following practices should be observed:

(1) *Employment of engineer troops.*—Engineers should be employed primarily on work requiring technical skill or special equipment, and should be assigned tasks suited to their equipment and strength in accordance with priorities based on the importance of the work to the entire unit. Unit commanders should provide engineers with any additional transportation or working parties from other arms needed to accomplish assigned tasks in accordance with priority schedules. See also paragraph 259.

(2) *Execution of engineer work by troops of other arms.*—Whenever an engineer officer is charged with execution of works requiring labor by troops not under his command, he should requisition the necessary troops from his unit or im-

mediate commander. This requisition should specify the number of officers and men required, together with the time and place, and the name of the engineer officer to whom they will report. The commander of the requisitioned troops should provide officers and noncommissioned officers required to effect execution of the work in accordance with the technical instructions given by the engineer officer in charge. The engineer officer in charge, either directly or through officers or noncommissioned officers representing him, should point out on the ground what is to be done and should provide the necessary technical assistants (see AR 100-5).

(3) Normally all work of organization of the ground, including obstacles and mine fields for close-in defense and camouflage, is executed by the troops who are to occupy and defend the work. Engineer troops furnish necessary engineer tools, supplies, and technical advice and assistance. Engineers are used to create obstacles and mine fields on exposed flanks and in the rear and other works which distinctly benefit the command as a whole or require special skill and equipment. Siting and construction of rearward defensive positions are frequently delegated to engineers.

(4) *Demolitions.*—(a) When and in what tactical situations to prepare vital structures such as important bridges for demolition is a major decision of the commander of the forces affected. In a retrograde movement failure to effect important demolitions or partial destruction of communications in the hope that they may be used later when our own forces resume the attack is seldom justified. The probable result will be that advance of the enemy will not be hampered as much as it might have been, and that he will execute complete destruction if forced to withdraw in turn. Small hostile armored forces or fighting groups and parachutists transported by air can seize and hold vital objectives such as bridges for limited periods for the purpose of assisting the rapid advance of hostile main forces or destroying such objectives to deny their use by our own forces.

(b) Once prepared, the moment of effecting demolitions assumes grave importance, and responsibility for ordering the execution thereof must be definitely fixed. Major demolitions such as destruction of vital bridges will be executed only

in accordance with the orders of the commander of the forces affected. The execution of less important demolitions may be left to the discretion of local commanders. The engineer officer detailed to prepare and execute a demolition should be given orders in writing stating both the title of the officer designated to give the order to fire the demolition, and also the special emergency circumstances in which the demolition will be fired should the officer indicated not be available.

(c) In any general plan of demolitions, there must be provided a system of communication, capable of functioning under the most adverse conditions, between the responsible tactical commander and the engineer demolition parties at various sites. Only in this manner, coupled with accurate information of location and movements of friendly forces, can premature demolition or capture of vital crossings by the enemy be avoided. Nevertheless, the commander of each demolition party must take such security measures as are necessary to prevent his surprise by fire or assault from any direction. When it is apparent to the demolition party commander that the structure cannot be kept from falling into enemy hands, it should be destroyed. A plan of retirement should provide for floating bridges or other emergency measures to cross rear-guard troops that have been cut off rather than temporize in such situations.

(5) *Engineers as combat reserve.*—When combat is imminent, engineers may be ordered to be prepared to assemble on short notice as a general reserve. However, such action should be taken only after carefully weighing their limited value in combat against the limitations imposed by restricting their freedom of action in performing valuable engineer work as well as its complete suspension. When sent into action as infantry they should be committed as a unit under their own commander.

■ 4. BASIS FOR ENGINEER PLANNING.—To effect the maximum coordination with other arms and to render them the greatest service possible, engineers should base their actions upon the following considerations:

a. *Priorities.*—The first necessity in engineer planning is a clear determination of priorities of engineer work. Such priorities are based upon the needs of the unit as a whole to

fulfill its tactical mission in the most efficient and coordinated manner. Normally the priority of engineer tasks in any situation is determined by the unit engineer based on study of the tactical plan and consultation with the general and special staffs. However, in case of conflict or doubt, the unit engineer should obtain a clear determination of the relative importance of tasks, securing approval of the unit commander if necessary. Only in this manner can the work be kept within the scope of possible performance and the engineer effort properly conserved and applied.

b. Simplicity.—All work of engineers in war should be simple in conception, design, and execution. No construction should be better than is necessary to meet bare requirements. It should be accomplished with greatest possible economy of material and force in minimum time, and plans therefor should be flexible to meet priorities changing with the tactical situation. For most structures, factors of safety can be extremely low and standards of durability limited. Standardization is desirable and will facilitate work in rear areas; however, in advanced areas economy of materials and transportation may often dictate a deviation from standard design and resort to expedients utilizing locally available resources. Officers and men alike must be trained in locating materials by engineer reconnaissance, and in employing maximum ingenuity, resourcefulness, and common sense.

c. Supply.—The enormous tonnage of engineer supplies required in active operations of any magnitude makes it imperative to limit drastically the number of items to be stocked through maximum use of standardization and use of designs of the utmost simplicity. Local resources in such supplies should be fully exploited in order to economize still further in transportation, especially in moving situations.

d. Decentralization.—Tasks should be laid out in advance and assigned to specific units. Variety and range of engineer tasks result in wide dispersion of engineer troops. Best results are obtained by decentralizing responsibility for execution, delegating authority, and encouraging initiative. Control is centralized under one head and effort is coordinated by frequent inspections and periodic reports.

e. Reconnaissance.—Systematic engineer reconnaissance is a continuing duty in order to permit careful anticipatory planning.

f. Security.—Unless special provisions are made, engineers at work are responsible for their own local security (see par. 34.)

g. Distribution.—The bulk of the engineer work is found behind the area occupied by the front-line divisions and is executed by engineers of the corps, the army, and the communications zone. It is here that major construction projects and heavy work on routes of communication must be executed. With front-line divisions, engineer work is of pioneer and temporary nature to meet immediate needs.

SECTION II

UNITS

■ 5. CLASSIFICATION.—Engineer units are classified as general, special, and headquarters.

a. General troop units.—Trained for general engineer work and perform most of the engineer work in the theater of operations.

b. Special troop units.—Trained for and perform their special technical engineer tasks.

c. Characteristics.—All engineer troop units have certain characteristics in common pertaining to their organization, equipment, armament, training, and combat functions. These common characteristics discussed in the following sections supplement special instructions contained in succeeding chapters covering the different types and technical duties of general and special engineer units.

d. Engineer headquarters.—Provided for area commands, for tactical units higher than the division, and for railway operation and other special engineer activities. Division engineer headquarters is provided by the organic engineer component of the division.

■ 6. TYPES.—*a. General engineer troops.*—(1) *Combat battalion.*—Organically assigned to the triangular infantry division. It consists of a headquarters, headquarters company,

and three lettered companies. It is completely motorized, including motors for all personnel.

(2) *Combat regiment (square division)*.—Organically assigned to the square infantry division. It consists of a headquarters, headquarters and service company, and two battalions of three lettered companies each. It is completely motorized, including motors for all personnel.

(3) *Squadron*.—Organically assigned to the cavalry division. It consists of a headquarters, headquarters and service troop, and two lettered troops. It is completely motorized, including motors for all personnel.

(4) *Engineer battalion (armored)*.—Organically assigned to the armored division. It consists of a headquarters and service company, three lettered companies, and a bridge company. It is completely motorized, including motors for all personnel.

(5) *Combat regiment (corps)*.—Organically assigned to the corps. In general, it is organized similarly to the divisional combat regiment, square division, but is equipped for heavier work than is the divisional combat regiment. It is completely motorized, including motors for all personnel.

(6) *General service regiment*.—Organically assigned to army and higher echelons. Its organization and equipment are in general similar to those of the combat regiment (corps). It does not have motor transportation for all personnel.

(7) *Engineer regiment (aviation)*.—Organically assigned to the GHQ Air Force, and executes general engineer work for air force units thereof. It consists of a headquarters, headquarters and service company, and three battalions each of a headquarters, headquarters company, and three lettered companies. It is completely motorized, including motors for personnel. It is equipped with a large amount of heavy equipment for leveling and paving landing fields.

(8) *Separate battalion*.—Organically assigned to army and higher echelons. It consists of a headquarters and service company and four lettered companies. It has a smaller percentage of officers, smaller overhead, and fewer occupational specialists than other general engineer units. It does not have transportation for personnel.

b. Special engineer troops.—Where the need is so great as to require additional special troops such units as forestry, mining, inland waterway service, or other special units may be organized. Special engineer units normally provided are—

(1) *Camouflage.*—(a) *Army camouflage battalion.*—Primarily for camouflage inspection, discipline, and training in the army areas.

(b) *GHQ camouflage battalion.*—Primarily for camouflage manufacture and supply in rear of army areas.

(2) *Ponton.*—(a) *Light ponton company.*—Equipped with the light ponton that provides a 10-ton bridge that will take normal division loads and can be reinforced for heavier loads. It contains three units of equipment, each providing a bridge 250 feet long.

(b) *Heavy ponton battalion.*—Equipped with the heavy ponton used for a bridge of 25-ton capacity. It contains equipment for four bridges, each 250 feet long.

(3) *Railway.*—(a) *Railway operating battalion.*—Operates and maintains a railway division of from 50 to 120 miles, and includes a company for train operation, a company for maintenance of way, and a company for light shop operation.

(b) *Railway shop battalion.*—Handles the heavy shop work of several railway operating battalions. Its shop equipment is not mobile.

(4) *Mapping.*—(a) *Corps topographic company.*—Makes, procures, and reproduces maps for the corps. It increases the density and extends control for field artillery fire. It is equipped with mobile printing and photographic equipment mounted in van-type trailers.

(b) *Army topographic battalion.*—Makes, procures, and reproduces maps for the army. It includes units for survey, topography and drafting, and a portable map reproduction plant.

(c) *GHQ topographic battalion.*—Similar to the army battalion except that its primary function is map reproduction and printing. Its reproduction plant contains heavier machinery and has less mobility.

(5) *Supply, maintenance, and transportation.*—(a) *Water supply battalion.*—Equipped to pump, purify, store, and trans-

port water. It includes 15 tank truck sections of six 750-gallon tank trucks each, and 9 mobile water purification units.

(b) *Depot company*.—Operates engineer depots and other engineer supply points. It contains three depot platoons.

(c) *Mobile shop company*.—Executes 3d echelon maintenance for all equipment for which the engineers have maintenance responsibility.

(d) *Dump truck company*.—Transports road and other materials for engineer operations.

c. *Engineer headquarters*.—Provide personnel and special engineer equipment for offices of unit engineers and their staffs. Engineer headquarters are provided for the corps, army, communications zone and its section, GHQ, and GHQ Air Force.

d. *Special engineer headquarters*.—Railway headquarters and railway grand division headquarters control the operation of military railways in the theater of operations. Inland waterways and other headquarters are organized to form the command groups for inland waterways and other special operations as necessary.

■ 7. ASSIGNMENT.—a. Engineer troops are assigned to division and higher units or headquarters in such numbers that it will not normally be necessary to divert other troops to engineer tasks. The number and types of engineer units so assigned depend on size and composition of the division or higher unit, and on amount and type of engineer work involved in the particular situation.

b. Normal assignments of engineer units to various large units and headquarters are shown in table I, appendix II, including totals for their assignment to a balanced GHQ force.

■ 8. EMPLOYMENT.—a. *Divisional engineers* execute all engineer work in the division areas except those tasks taken over by corps engineers or otherwise excepted from divisional control. The work of divisional engineers can and must satisfy only the most immediate tactical requirements and hence is frequently of a temporary nature hurriedly done with whatever materials are readily available. When the situation demands, divisional engineers may be reinforced

by attachments of engineer units from corps or higher echelons.

b. Corps engineers execute all engineer work within the corps areas in rear of the component divisions. They normally extend their responsibility for construction and maintenance of roads and bridges into the rear of division areas so as to free divisional engineers for work in the most advanced areas. The work of corps engineers is less dependent on the immediate tactical situation than is the work of the divisional engineers, and hence is usually of a more permanent nature and more extensive. Heavy, intricate, or extensive work required within the corps areas may be turned over to army engineers, or the corps engineers may be reinforced by attachments of engineer units from army or GHQ reserve. If a corps is acting independently, it must be reinforced by such engineer units as are required to perform tasks usually handled by army engineers.

c. Army engineers execute all engineer work within the combat zone in rear of the corps areas. They frequently take over construction and maintenance of some routes of communication and performance of some special tasks in corps areas in order to free corps engineers for work farther forward. Army engineer work is generally more dependent on strategic requirements than on tactical situations, hence the type of construction is of a more permanent nature than that performed in the corps areas and is preceded by more comprehensive planning. Army engineers are reinforced from GHQ reserve as circumstances demand.

d. GHQ reserve engineers are provided to meet all contingencies beyond the capacities of the engineers allotted to the armies and lower units. They include sufficient engineers to accomplish all engineer work in the communications zone, plus a reserve of engineers available as reinforcements or for separate missions under GHQ.

e. GHQ Air Force engineers are provided to perform any engineer work, particularly extensive leveling, grading, draining, and construction of facilities needed for air fields used by the GHQ Air Force.

SECTION III

ORGANIZATION

■ 9. HEADQUARTERS.—Engineer headquarters are separate organizations contained in the corps and higher units. Division engineer headquarters is organically part of the engineer troop complement of the division. Regimental and battalion engineer headquarters are organically part of those units and are discussed in paragraphs 10 and 11. An engineer headquarters organization consists essentially of the unit engineer and his staff.

a. Unit engineer (see par. 3).—(1) *Duties*.—The unit engineer is responsible for carrying out within the area over which his unit commander has control (see fig. 1) the duties prescribed for engineers (see par. 2), except those which may have been taken over by higher echelons or otherwise exempted by higher authority. The unit engineer is a member of the special staff of the unit commander, and is in command of all engineer troops directly assigned to the unit, but not of those assigned to subordinate units.

(a) As the engineer officer on the special staff of the unit commander, he advises the latter on matters pertaining to the accomplishment of the engineer mission (see par. 1). He coordinates the work of all engineer troops by preparation of plans and orders generally issued in the form of annexes by the unit commander. He is responsible as a staff officer for plans and preparation of certain general instructions for troops of all arms in matters closely related to engineer work such as traffic control, regulations for use of bridges, etc. He is also responsible for the supply of engineer equipment and materials to the units. For a list of detailed duties, see FM 101-5.

(b) In his capacity as commander of organic and attached engineer troops, he is responsible for initiation and execution of all engineer work necessary to further the tactical and strategic operation of the unit (see AR 100-5).

(2) *Functional relation* (see fig. 2).—(a) The relationship between the unit engineer of any unit and the unit engineer of a subordinate unit is not one of command. Any instructions he desires carried out by lower units must be incorpo-

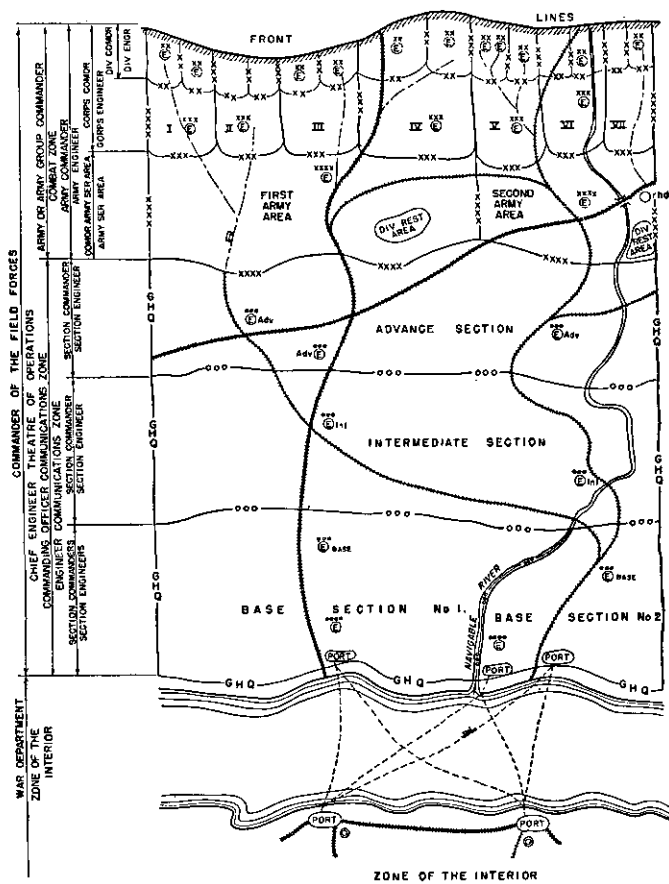


FIGURE 1.—Engineer service areas in the theater of operations.

subordinate units. It is his duty to supervise by means of these inspections and reports the work of the subordinate units to the extent necessary to insure its execution in accordance with plans of the unit commander (see FM 101-5.) A spirit of cooperation between the unit engineers of all echelons is essential.

(b) The unit engineer confers with other members of the special staff in preparation of plans or projects in which they may be concerned so that when a plan is presented to the unit commander for approval it will carry as full concurrence as possible. The unit engineer keeps in close touch with commanders of all other components of his unit. By so doing he develops an understanding of the engineer requirements of these components and is able to give sound advice and timely assistance in solution of their problems.

b. Staff.—(1) *Size.*—The size of the staff of an engineer headquarters depends on the size of the unit to which it pertains and the extent and responsibility of engineer operations.

(2) *Functional relation.*—Staff officers, although charged with duties and functions which apply to the unit as a whole, must constantly bear in mind that these duties and functions are primarily the responsibility of the unit commanders. Any directions or instructions issued to subordinate staffs or units must be transmitted through the proper channels of command, and not between corresponding staff officers of higher and lower units. Staff officers render professional assistance to unit engineers and act as their agents in harmonizing plans and operations. In their relationship with subordinate engineer commanders (organic and attached), staff officers must remember that, without responsibility, they have no prerogatives of authority.

(3) *Organization.*—The staff consists of an executive officer and four sections, personnel and administrative, intelligence, plans and training, and supply. In staffs of regiments and smaller units these sections are termed S-1, S-2, S-3, and S-4, and in divisions and larger units G-1, G-2, G-3, and G-4, respectively. Due to the increased scope and technique of engineer duties in the army and higher units, these four sections constitute an "executive staff" group, and a second staff group is added known as the "engineering staff." In the

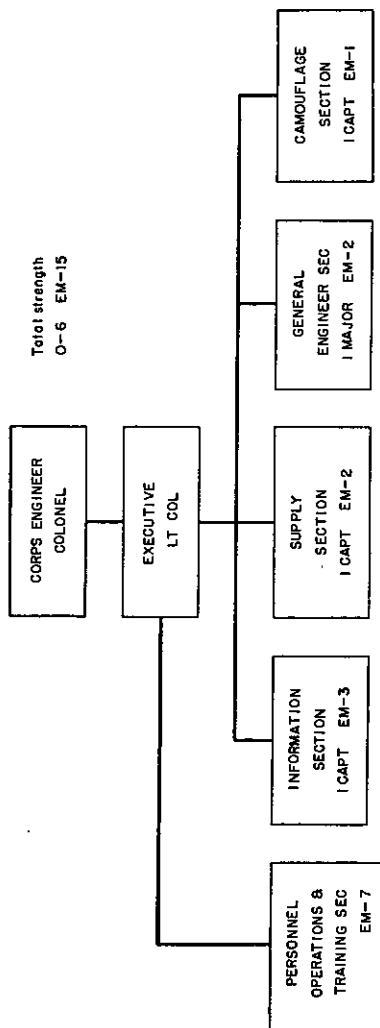


FIGURE 3.—Engineer headquarters, corps (T/O 5-100-1).

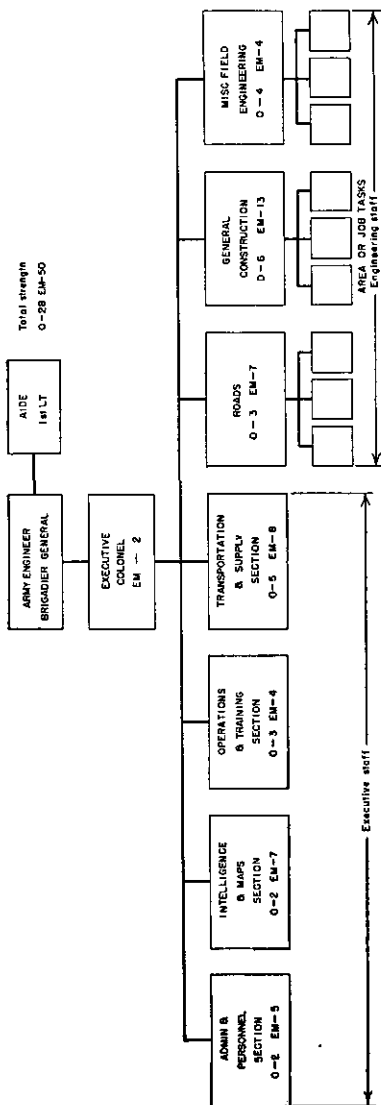


FIGURE 4.—Engineer headquarters, army (T/O 5-200-1).

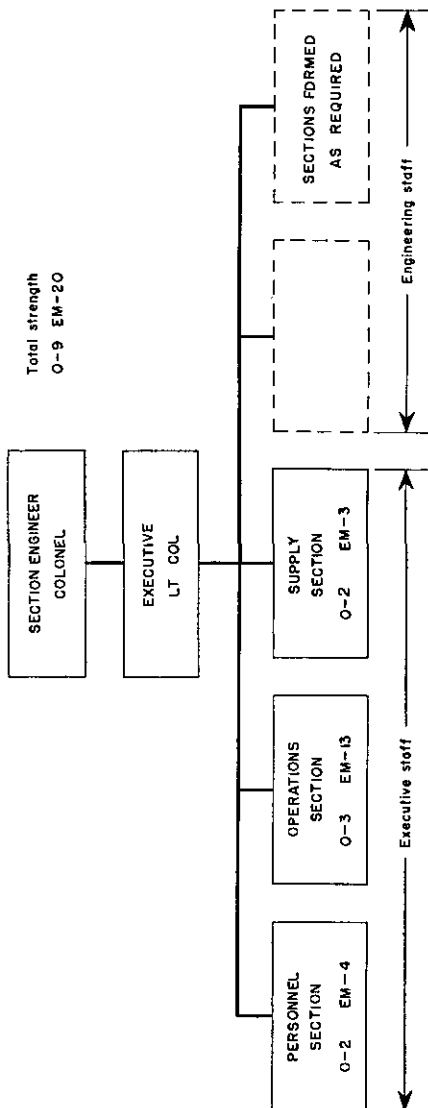


FIGURE 5.—Engineer headquarters, communications zone section
(T/O 5-601-1).

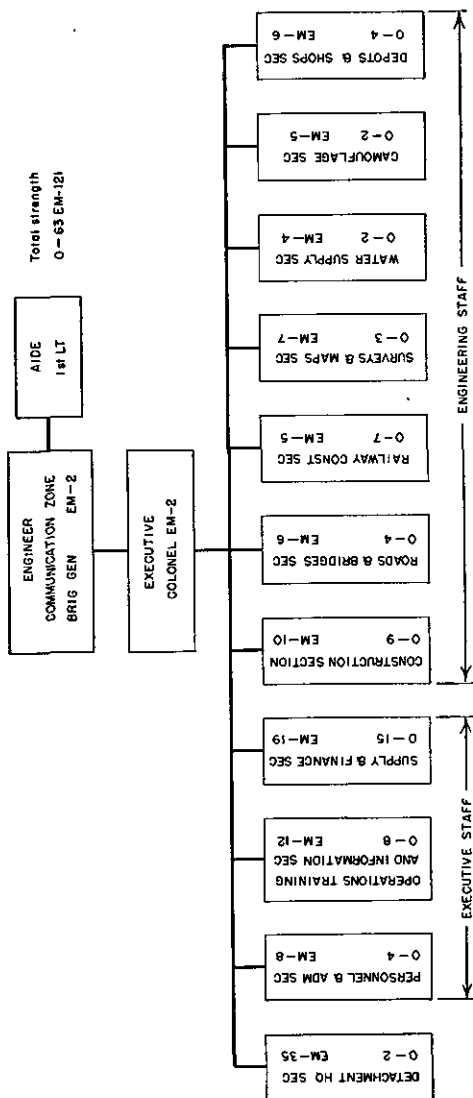


FIGURE 6.—Engineer headquarters communications zone (T/O 5-600-1).

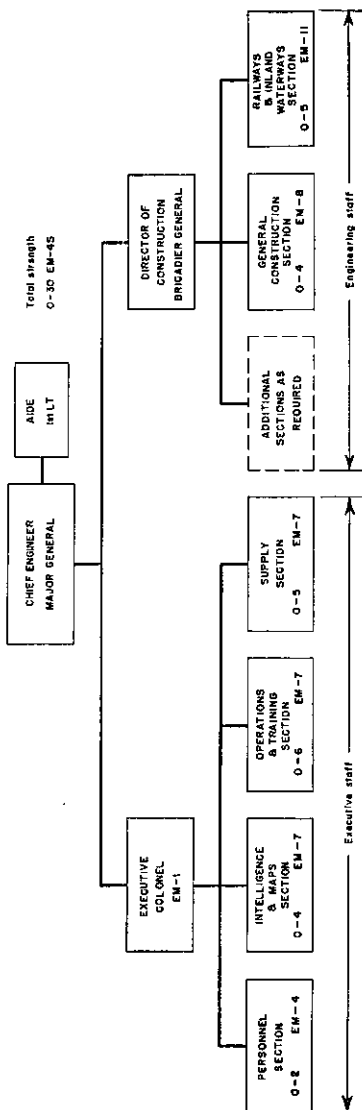


FIGURE 7.—Engineer headquarters, GHQ (T/O 5-300-1).

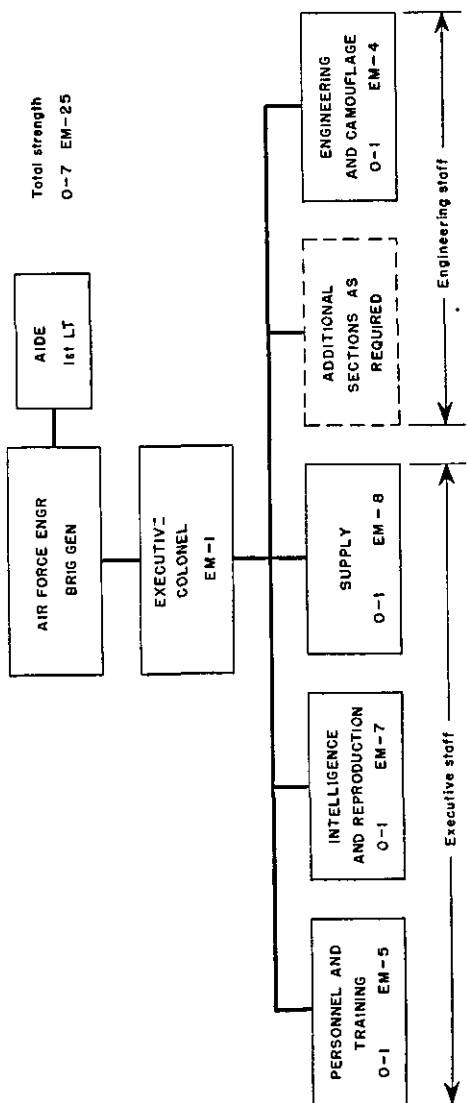


FIGURE 8.—Engineer headquarters, GHQ Air Force (T/O 5-400-1).

corps and below, the "executive staff" alone constitutes the staff of the unit engineer (see Figs. 3 to 8, incl.).

(4) *Executive officer.*—The executive officer is responsible for work of the staff, and for control and coordination of troop operations under orders of the unit engineer. He must enjoy the latter's complete confidence and have considerable independence in order to be able to relieve the unit engineer of details. The unit engineer is thus afforded time for reconnaissance, inspection, and contact with the unit commander and other staff officers for a better grasp of the situation as a whole. The executive officer acts for the unit engineer in the latter's absence.

(5) *Executive staff.*—The executive staff operates in accordance with the staff procedure prescribed in FM 101-5 and FM 101-10.

(a) *Personnel and administrative section.*—Handles personnel and administrative matters for engineer units as prescribed for the first staff section in FM 101-5.

(b) *Intelligence section.*—Plans and supervises collection, evaluation, and dissemination of engineer information, and for division engineer and lower units, combat intelligence in the area or zone assigned the unit. Technical information collected includes natural and commercial resources and data on engineering structures both in friendly and hostile territory. This section also compiles information on technical accomplishments and progress of engineering operations. It plans surveys and mapping activities involving participation by the Air Corps and artillery. It has full responsibility for all map distribution.

(c) *Plans and training section.*—Allocates engineer troop reinforcements to lower echelons based on the engineer situation. In accordance with the decision of the unit engineer, it prepares orders for issue to troops under his command. It prepares the engineer paragraphs of and the engineer annexes to orders issued by the unit commander. It arranges details of the engineer troop movements based on unit field and special orders. It prepares records and keeps the unit engineer abreast of the current tactical and engineer situations in such manner as to permit quickly the preparation of an engineer estimate. It devises policies for con-

duct of engineer training activities, including schools, and for training troops of all arms in field engineering. In units below the army it plans specific technical work and engineer operations to accomplish the engineer mission, and functions generally in this respect as does the engineering staff of higher engineer headquarters (see (6) below).

(d) *Supply section.*—Cooperating with the intelligence section, studies and collects detailed information on local resources, available credits in depots and other stocks under unit control, and captured enemy supplies in order to advise the unit engineer as to availability of equipment and materials essential to proposed operations. The section plans forward or rearward displacement of engineer depots and stocks in accordance with the tactical situation. It arranges for conservation or destruction of engineer supplies relinquished by lower echelons in forward or retrograde movements. It allocates transportation to subordinate units. It examines engineer requisitions, both for engineer troops and other arms, and designates issuing depots or agencies. Where stocks under unit control are insufficient, this section studies engineer requirements in advance of operations and determines credits to be requested or stockages under unit control to be built up or replenished by higher echelons. Peak labor demands at engineer depots or other installations are foreseen as far as possible in advance and allocations or transfer of engineer depot troops or labor organizations are requested promptly.

(6) *Engineering staff.*—The engineering staff is primarily a technical planning and inspection agency for engineer operations. It does not direct or supervise the work. It keeps the unit engineer informed as to progress and conformity of engineer work to provisions of his instructions and orders of unit commanders. Such duties embrace such activities as roads and bridges, including traffic regulations; general construction; water supply; utilities; railways; demolitions; camouflage; and fortifications. While the foregoing are normal activities, the situation in the particular theater of operations may require sections for additional types of operations such as inland waterway transportation, forestry, and military mining.

c. Engineer headquarters.—Include the unit engineer, the executive officer, the officers of the various staff sections and the enlisted personnel necessary for administration and operation in each section. They include such specialists as lithographers, draftsmen, surveyors, photographers, mechanics, clerks, and construction, supply, and camouflage experts.

d. Assignment.—Engineer headquarters are provided for the corps, army, communications zone, communications zone sections, GHQ, and GHQ Air Force. They are also provided for special engineer services such as military railways, railway grand division, and inland waterways. Although no Tables of Organization are provided, it may be necessary to organize special engineer headquarters for additional engineer services in the theater of operation such as forestry, quarries, etc., should the situation demand. For normal assignment of engineer headquarters to a balanced GHQ force, see table I, appendix II.

e. Equipment.—Equipment of an engineer headquarters includes standard sets of office, photography, drafting, and map reproduction equipment, and a portable electric lighting unit.

f. Office space.—The following table gives minimum requirements in office space necessary for the various engineer headquarters:

Engineer headquarters	Square feet
Corps.....	1,200
Army.....	2,800
Communications zone.....	8,000
Communications zone section.....	1,500
GHQ.....	5,000
GHQ Air Force.....	2,800

■ 10. REGIMENT.—*a. Components.*—The regiment consists of a headquarters, a band, a headquarters and service company, two or more battalions, a medical detachment, and a chaplain. The headquarters includes the regimental commander and his commissioned staff.

b. Headquarters.—(1) Where the regiment is the sole engineer unit either organically or attached to a command, the regimental commander is unit engineer (see par. 9a).

(2) *Regimental staff.*—Duties of the regimental staff correspond generally to those of the executive staff described in paragraph 9b (5) with the following modifications:

(a) *Executive officer.*—See paragraph 9b (4).

(b) *Adjutant (S-1).*—In addition to the duties prescribed above, he commands the band, is responsible for administration of interior guard duty, and for regimental entertainments and athletics.

(c) *Intelligence officer (S-2).*—In addition to his mapping and other technical duties prescribed above, the intelligence officer of a general engineer unit is responsible for combat intelligence. No specific personnel are provided for this purpose as for other combat arms. When a general engineer unit is employed in combat, the intelligence officer assisted by a small detail of headquarters personnel collects, evaluates, and distributes information of the enemy as prescribed in FM 101-5.

(d) *Operations officer (S-3).*—In addition to the duties described in paragraph 9b, he is specifically charged with preparation of training programs, schedules, and requirements for training inspections; disposition of electric lighting, pumping, and similar units of special mechanical equipment assigned to headquarters and service company; and is regimental gas officer.

(e) *Supply officer (S-4).*—Responsible for the supply of engineer materials and equipment for the unit when the regiment is the sole engineer troop unit either organically a part of or attached to a command. He makes or causes to be made engineer reconnaissance within the unit area for local sources of supply. He is responsible for the procurement and issue of supplies of all classes (I, II, III, IV, and V; see FM 100-10) for the regiment.

(f) *Assistant division engineer.*—Provided in the engineer component of the cavalry and infantry divisions is the personal representative of the division engineer at division headquarters and acts for him in his absence in accordance with his announced policies.

(g) *Regimental surgeon*.—Senior medical officer with the medical detachment and serves both in an advisory and administrative capacity.

(h) *Chaplain*.—In charge of religious activities, and assists in general welfare work, entertainment, athletics, and other means of maintaining morale.

c. *Headquarters and service company*.—The headquarters and service company is divided into a company headquarters; a headquarters platoon which furnishes enlisted personnel for the staff sections of regimental headquarters; and a service platoon which furnishes transportation and repair service and operators for certain equipment for the entire regiment. The company headquarters, in addition to the normal functions for the company administration, mess, and supply (see par. 12a) operates the regimental (or battalion) officers' mess.

d. *Band*.—(1) The band is usually attached to the headquarters and service company for rations and quarters, but may be attached to any company. Its primary function is to furnish music for the regiment, but under combat conditions it may be used to assist in maintenance of supply or as litter bearers.

(2) The band leader is a warrant officer. He is in immediate charge of the band and responsible for musical instruction.

■ 11. **BATTALION**.—a. Independent engineer battalions and squadrons are organized into a headquarters, a headquarters and service company (troop) or headquarters company, either two or more lettered companies or troops, and a medical detachment. The duties of the battalion commander and his staff are similar in general to those given in paragraph 10 for the regimental commander and his staff, except that in the battalion certain staff functions are combined under one officer and the commanding officer of the headquarters and service company or troop is also the battalion supply officer (S-4). The battalion headquarters and service company (troop) or headquarters company has similar functions to the headquarters and service company of the regiment (see par. 10c) but is organized into a company

or troop headquarters and various functional sections without a platoon organization.

b. Battalions which are components of regiments (except aviation) have a small battalion staff but no headquarters and service company or medical detachment and hence are not suited for independent missions unless provided with the necessary service personnel. Aviation battalions have a headquarters company that permits it to operate independently.

■ **12. COMPANY.**—The company is divided into a company headquarters and either two or three numbered platoons.

a. Company headquarters.—The company commander is responsible for administration, training, supply, messing, welfare, discipline, and employment of his company. In some units there is an additional officer in company headquarters. The first sergeant is responsible under the company commander for maintenance of all company records, interior administration, and police. The mess sergeant is in charge of procurement and preparation of the ration and of feeding the men. The motor sergeant is in general charge of care and operation of motor vehicles. The supply sergeant is in charge of procurement and issue of equipment and supplies and care of company stocks. Other sergeants are technical specialists charged with supervision of special operations. The other personnel of company headquarters include cooks, clerks, chauffeurs, draftsmen, and technical specialists.

b. Platoon.—The platoon is divided into a headquarters and an operating section. The headquarters includes the platoon commander (lieutenant), platoon sergeant, tool corporal, and chauffeurs and motorcyclists. The operating section includes the bulk of the platoon personnel organized into operating units (squads) which in the case of completely motorized units have organic tools and transportation.

■ **13. MEDICAL DETACHMENT.**—Each regiment and independent battalion includes a medical detachment of two or more medical officers and several enlisted men in its organization. Its routine equipment and medical supplies are sufficient for first-aid treatment and light sickness not requiring hospitalization. For mess and routine supplies it is attached to one of the

companies. It is provided with its own transportation. The medical detachment operates most efficiently when used as a single unit. Its primary function is to set up aid stations for collection of casualties from which the more serious cases are evacuated by the division or higher unit ambulance services. The detachment commander as surgeon on the staff of the regimental or battalion commander is responsible for sanitation and measures insuring health of the command. The detachment maintains a routine dispensary and sick call for minor ailments.

■ 14. TABLES OF ORGANIZATION.—Detailed organization of each engineer unit is prescribed by the War Department and is published in a Table of Organization (T/O). All Tables of Organization for engineer units have the basic number 5 before the table subnumbers. Abbreviated engineer Tables of Organization are given in appendix II. Unless stated otherwise the given strength of engineer units is the number of engineer personnel alone and does not include medical detachments and chaplains.

SECTION IV

EQUIPMENT AND ARMAMENT

■ 15. GENERAL.—Equipment issued engineer organizations is prescribed in Tables of Basic Allowances (T/BA) and the Engineer Supply Catalog. For each supply arm or service there is a section in these tables which lists the items furnished by that arm or service (air corps, chemical warfare, engineer, medical, ordnance, quartermaster), and the basis of issue per organization and individual. "Troop equipment" is the term applied to all equipment issued to any particular unit as abstracted from the tables. Although not so shown in Tables of Basic Allowances, troop equipment is grouped for purposes of discussion herein into certain major categories referred to as organizational equipment, engineer equipment, transportation, and armament.

■ 16. ORGANIZATIONAL EQUIPMENT.—Organizational equipment consists of individual clothing, accoutrements, messing equipment, marking and cleaning kits, and other standard sets

issued generally to similar units of all arms. Since issue and purpose of such equipment is the same for all engineer units, they are not discussed in subsequent chapters but are summarized below.

a. Companies are issued organizational equipment corresponding to their distinctive functions of handling interior administration and economy; messing, sheltering, and being otherwise responsible for the daily sustenance of men and care of equipment.

b. Regiments and independent battalions are issued additional organizational equipment corresponding to their increased administrative functions. Such equipment is not issued to the headquarters itself, but to pertinent headquarters and service companies or troops as part of their organizational equipment. It includes additional tentage, officers' mess equipment, typewriters, mimeograph machines, and similar administrative accessories. It also includes equipment for signal communications.

c. Engineer headquarters are issued organizational equipment necessary for enlarged administrative duties; for shelter, messing, and care of unit engineer and his staff; and for enlisted personnel of the headquarters. The basis of issue in Tables of Basic Allowances is the number of officers and men comprising the particular headquarters. The items of equipment correspond generally to those issued both to a company and to a headquarters and service company.

d. Use.—Organizational equipment is utilized as a rule by special personnel included in company headquarters. Thus the first sergeant is assigned and held responsible for administrative equipment comprising field desks, typewriters, and other equipment used by company clerks and orderlies. Similarly, the mess sergeant is responsible for field ranges, cooking utensils, kitchen tentage, etc., and the supply sergeant for stock of all spare equipment, for marking and cleaning equipment, repair kits, etc. In some cases platoons are issued a few items of organizational equipment such as litters. Similarly, squads are issued sewing kits and a few similar items for field service conditions. Each individual is issued and held responsible for clothing, individual equipment, and arms issued him.

■ 17. ENGINEER EQUIPMENT.—Tools and transportation are the primary equipment of engineer troops. Since they are the basis of engineer work and differ with the type of organization, engineer equipment will be discussed in detail in subsequent chapters under the unit to which it pertains. As a general rule, tools and machinery issued are standard commercial items. Hand tools form the basic equipment. They are usually issued in tool sets such as pioneer, carpenter, demolition, etc. Labor-saving machinery and mechanical devices form part of the equipment to as great an extent as practicable consistent with mobility. As a general rule, the more highly technical equipment in each unit is found in the headquarters unit, either for performance of highly technical work that forms a small but important part of the engineer mission, or for assignment to subordinate units for reinforcing purposes. Equipment issued to general engineer troops is based on needs for performing a wide variety of missions, while that issued to special engineer troops is designed specifically for accomplishing the task for which they are organized (for example, surveying and map reproduction equipment for topographic battalions; water purification equipment for water supply battalions, etc.).

■ 18. TRANSPORTATION (see sec. II, ch. 11).—All engineer transportation is motorized. It consists principally of command or pick-up trucks for reconnaissance and inspection; light trailers for tools, equipment, and supplies; light dump trucks for hauling materials and supplies; heavy cargo trucks and trailers for carrying heavy machinery, ponton equipment, etc. Although cargo trucks are procured by the Quartermaster Corps and issued under Tables of Basic Allowances, trucks mounting special equipment such as air compressors, water purification units, etc., constitute engineer equipment and are discussed under that heading in subsequent chapters. All general engineer units except the general service regiment and separate battalion are completely motorized to include personnel carriers. Some special engineer units are also completely motorized.

■ 19. ARMAMENT.—The principal weapons issued combat engineer troops are the M1 rifle with bayonet and the caliber .30

machine gun. The caliber .45 automatic pistol is issued officers, certain noncommissioned officers, and a few specified privates. In addition the armored battalion has caliber .50 machine guns and caliber .45 submachine guns.

SECTION V

TRAINING

■ 20. GENERAL.—*a. Classes.*—All engineer soldiers are given basic military training. Engineer troop units are trained for coordinated action in engineer work. Combat training covers employment of the engineer in combat as infantry.

b. Characteristics.—(1) Basic training includes disciplinary, physical, and field service.

(a) Disciplinary training develops the habit of obedience, promotes teamwork within the organization, and develops morale and leadership. In order to emphasize smartness, precision, and attention, close-order formations and drills are prescribed for engineer units. Such drills will follow procedure prescribed in FM 22-5, the actual formations being modified as required due to differences in organization. The purposes of drill stated in FM 22-5 will be the guide in all drills. Any general procedures adopted by engineer units will be uniform within all subordinate units; for example, for all companies in a battalion or regiment.

(b) Physical training develops physique and physical condition of the soldier and hardens him for combat conditions. It includes competitive games as well as calisthenic drills.

(c) Training for field service teaches the engineer soldier how to care for himself and his individual equipment in the field. Such knowledge is not only important in fitting him into routine demands made of his unit, but also is the basis of his comfort and health. It includes care, maintenance, and repair of his clothing and individual equipment; first aid; healthful habits; individual cooking; and camp and shelter erection and routine.

(2) Engineer training (see pars. 23 and 24) embraces all training undertaken for the purpose of qualifying individuals and units in performance of duties relating to special classes of engineer work for which the units are responsible. While

basic and combat training are very similar in all engineer organizations, engineer training varies considerably with the type of organization. It will therefore be discussed in subsequent chapters. Procedure is first to train the individual to execute duties pertaining to his assigned specialty in the organization and then to train groups of individuals to execute combined tasks under their appropriate commanders. Technical specialists and machinery operators in headquarters and service companies and in company headquarters are trained by attachment to companies and platoons on routine work or engineer training which demands their specialties.

(3) Combat training prepares the unit for participation in combat and for security when on the march, in bivouac, or while employed on engineer work. In combat training engineer units are employed as organized and are not reorganized into provisional infantry organizations. Engineers use extended order drills as prescribed in FM 22-5. In combat, infantry methods and formations prescribed in FM 7-5 will be followed with such changes as are necessary due to differences in strength, armament, and organization.

c. Command.—Command training applies only to leaders but is of the greatest importance in accomplishing the increased tasks imposed by war. In peacetime commanders will delegate responsibility even at the expense of a few mistakes in order to develop leaders who will accept responsibility in war. The tendency of commanders of all echelons to exercise close supervision over all tasks assigned their units must be deliberately avoided. The basis of successful command training is a maximum of decentralization and a minimum of interference with subordinate commanders consistent with a satisfactory performance of the unit as a whole. Officers must know how to plan, estimate, and organize work, and how to allot tasks to subordinate units so as to insure that an assigned mission will be commenced promptly and executed rapidly without frequent cautions or instructions from superiors. Noncommissioned officers must know how to employ each private on productive work in execution of an organizational task.

d. Time.—The amount of time to be allotted to the various classes of training depends upon amount of time available and

rapidity with which results are obtained. Such results depend more on organization, interest, and value of training rather than upon hours consumed. During peace individuals may be trained to fill in a number of different positions in the organization, but during mobilization time will rarely permit training of such individuals in duties of more than one specific position.

■ 21. BASIC TRAINING TEXTS.—For a list of official military (War Department) publications that should be used as a basis in the preparation for and in the conduct of all basic training of engineers, see appendix I.

■ 22. ADAPTATION OF MOBILIZATION TRAINING PROGRAMS (MTP 5-1).—These programs, effective upon mobilization, cover a 13-week training period. When used as a basis for training engineer units for different periods of time, the methods of application, modification, and use given in that publication should be followed.

■ 23. GENERAL ENGINEER TROOPS.—a. Problems of training general engineer troops are similar to those common to other combatant arms and services as set forth in FM 21-5 (now published as TR 10-5) and MR 3-1. General engineer troops are trained in—

- (1) Construction of roads, bridges, and shelter.
- (2) Obstacles, demolitions, military mining, and field fortifications.
- (3) Operation of utilities in the theater of operations for which special troops of engineers or other arms are not provided.
- (4) Engineer reconnaissance.
- (5) Engineer supply.
- (6) Tactics applicable to their armament and organization.

b. Training of general engineer units may be carried out in almost any locality, but if possible the terrain and climate should approximate conditions expected in the proposed theater of operations. Ample areas should be provided for the great variety of training subjects which include most of those given infantry. Certain engineer subjects such as explosives and demolitions which require isolated areas as a safety precaution make additional areas necessary. The

terrain should vary from flat to rolling or mountainous, have numerous types of roads and bridges, dry and muddy ground conditions, with sand, clay, loamy, and rocky soils. There should be all kinds and sizes of standing timber, and streams and gullies of various depths and widths. The allotment of time to weapon and tactical combat training will be less than for infantry units as about half the time available will be required for technical or specialized engineer training. It is vital that engineers train with other arms and services in later stages for combined training as part of a combat team. If they can be trained together with the troops they will actually serve (for example, division engineers with their own division), esprit and cooperation will be greatly benefited.

■ 24. SPECIAL TROOPS.—For special engineer troops the proportion of time spent on various classes of training is modified as follows:

a. Basic training, being common to all types of units, is unchanged.

b. Combat training is given only the time necessary to acquaint the troops with use of weapons with which they are armed so that the unit may provide for security against air and ground raids.

c. Technical engineer training is given maximum possible time, especially in the military aspects of specialist work. Because of the skilled nature of the tasks on which these units are employed, personnel should be recruited from men trained in civil life to do the kind of work expected of them in the special unit to which assigned. It may be impossible to give specialist training in early stages of mobilization where equipment is not available. When equipment is available and during actual military operations, commanders of such units should constantly train additional personnel in all essential tasks, utilizing the apprentice system, to avoid having to wait for properly qualified replacements if losses occur. Casualties cannot then cripple work of their units, and expansion of units to meet emergencies may be made readily.

■ 25. BAND.—Training of bands and field music is conducted according to FM 28-5.

■ 26. ATTACHED MEDICAL.—Training of medical detachments is conducted by the unit surgeon according to FM 8-5 and other pertinent medical field manuals.

■ 27. TACTICAL INSPECTION.—The engineer commander supervises training of his unit and makes tactical inspections in which the unit is given a tactical mission appropriate to the unit and its equipment. This should be in the form of a problem or series of problems that will test the unit in march to, organization for, and execution of a definite engineer mission. Equipment and transportation are always present. Practical tests are conducted in use of special equipment carried by the unit either by requiring execution of a prescribed task or by inspecting work that has been done by the unit with this equipment.

■ 28. DRILLS AND TRAINING INSPECTIONS.—*a. Drill.*—In general, engineer work operations should not be hampered by formal drills. Methods of procedure described in the Engineer Field Manual are modified to suit conditions. Most tasks given an engineer unit present problems that must be solved on the ground by the unit commander using men, equipment, and materials available. This can rarely be accomplished by following a formal drill. When a unit is employed upon a task that involves a repetition of a number of identical operations or use of standard equipment such as erection of wire entanglements, construction of ponton bridges, and unloading and loading of tools, systematized organization for work may approximate a drill.

b. Inspection.—Inspections are executed in general accordance with rules prescribed for the class of troops with which the engineer unit is serving. They are not to be confused with technical inspections of structures or engineer work.

(1) Inspections of troop units without transportation are executed as for infantry. When held with transportation, tools and spare parts normally are laid out for inspection. Platoon commanders give commands to open and close ranks and to lay out and load tools. Tools are laid out as prescribed by the engineer or unit commander in several lines to the sides and rear of each vehicle within frontage of the unit. Space is left between sets to permit inspection.

(2) Training inspections are conducted from time to time by the unit engineer or unit commander to determine training progress and proficiency of engineer units in accomplishing typical tasks bearing on the engineer mission (see par. 1) under field conditions.

SECTION VI

COMBAT

■ 29. BASIC CONSIDERATIONS.—*a.* The primary mission of all engineer troop units is engineer work. They are armed with the rifle and automatic weapons primarily for their own local security. However, in an emergency they may be relieved of their engineer work and used as a tactical unit in combat as infantry. Due to the frequency of their employment in forward areas, general engineer troops must be thoroughly trained to meet such emergencies. In a division the responsibility for such a decision rests with the division commander, for he and his staff are the only ones who can weigh the advantage of using engineers as infantry against the disadvantage of abandoning engineer work. To permit the engineers to continue on engineer work and yet make them available for use as infantry in an emergency, the engineer subparagraph of the field order ordinarily contains the statement: “* * * engineers prepared to assemble at ——— on ——— hours’ notice.”

b. When used in combat, engineers follow the doctrine prescribed for infantry with such modifications as may be necessary on account of the differences between infantry and engineer units in organization, armament, and equipment. Engineers with armored units when used for combat in or with vehicles follow the doctrine prescribed for infantry with armored troops. Engineers with cavalry units when used in combat follow the doctrine prescribed for cavalry.

c. Engineer units are provided organically with a much smaller proportion of heavy weapons than infantry and cavalry. They do not have certain infantry weapons or certain important means of signal communication which permit highly effective teamwork. The combat power of engineer units is therefore not as great as that of corresponding units of infantry or cavalry.

d. Engineer units enter combat without changes in their basic organization. Small modifications may be made in order to employ with greatest effectiveness the weapons or-

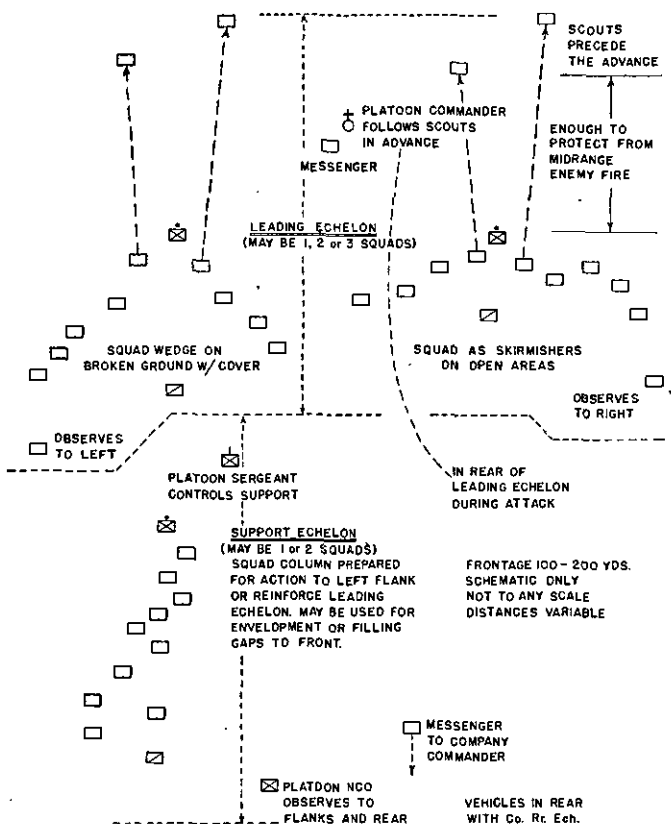


FIGURE 9.—Disposition of an engineer platoon of three 12-man squads in an attack as riflemen.

ganically assigned to engineers. Engineer platoons and larger units may be divided into forward and rear echelons for combat as shown in figure 9. The forward echelon comprises the fighting elements and the command section of head-

quarters. The rear echelon comprises the transportation and engineer equipment and the administrative and supply sections of headquarters. All rear echelon personnel, transportation, and equipment may be assembled under control of the headquarters of the next higher unit. Composition of these two echelons is not fixed and may be varied as conditions require.

e. In preparation for combat as infantry, provision must be made for protection and proper location of engineer equipment and transportation, having in mind early resumption of engineer work. Special arrangements must be made for additional supply of ammunition.

■ 30. SPECIAL TROOPS.—Use of special engineer units in infantry combat as riflemen is rare. Their principal combat missions are to protect operations of the units themselves when at work and to provide security when they are in movement or in bivouac, particularly against air attack. So far as practicable, they enter combat without changes in their basic organization. Special provisions must be made for their supply of ammunition.

■ 31. COMBAT INTELLIGENCE.—a. *Definition.*—Combat intelligence is evaluated and interpreted information secured in the field concerning the enemy or theater of operations, together with the conclusions drawn therefrom (FM 30-5). It includes a continuing knowledge of location, strength, composition, armament, equipment, supply, tactics, training, discipline, morale, movements, capabilities, conditions, and situation of the enemy forces opposing a combat unit, and terrain over which the combat unit is to operate or is operating. This intelligence furnishes a basis for the tactical decisions of the commander (see also pars. 284 to 293).

b. *Responsibility for collection.*—Each commander of a combat unit is responsible for securing information concerning the enemy forces opposing him. In general, the staff agency for combat intelligence is the intelligence (S-2) section. Operating personnel may include any persons or groups who may be directed to procure information; in addition, all units report regularly through command channels enemy strength, dispositions, fires, movements, captured doc-

uments, and other information gained. Prisoners are questioned and handled as prescribed by higher authority.

c. Training and employment.—Personnel used for intelligence work are trained and employed in accordance with the doctrine prescribed in FM 30-5, 30-15, and 21-45. In engineer units since no specific personnel is provided for combat intelligence but only for engineer intelligence, a small group should be trained in this duty.

■ 32. AMMUNITION SUPPLY.—*a. Initial.*—Part of the initial supply of ammunition carried by combat engineers is on the individual soldier, part in the engineer train, and the balance in the unit quartermaster trains. (See Tables of Basic Allowances 5 for amounts authorized.) The part carried in the engineer and quartermaster trains is issued prior to or during combat. Vehicles in the engineer train normally are used for procuring and distributing replenishments of ammunition for elements of the unit.

b. Distribution.—(1) Distribution during combat is accomplished through ammunition dumps established by the regiment, battalion, company or similar units which are stocked initially by dumping the loads of the engineer and/or quartermaster train.

(2) In such units the supply officer is responsible for procurement of ammunition and its delivery to battalion or company ammunition dumps as far forward as is reasonably safe. He uses vehicles from the units served or headquarters vehicles. If necessary carrying parties are used to deliver ammunition to dumps.

(3) The battalion and company commanders are responsible that their units are supplied with ammunition from dumps. They may handle this by detailing carrying parties from the units in reserve. If desired such parties need not return, but may remain as reinforcements or replacements at the front. If it is not practicable to send carrying parties forward, units in the firing line send back details to ammunition dumps.

(4) The doctrine of ammunition supply given above applies to all engineer units, general or special, when engaged in combat. The vital importance of providing adequate sup-

plies of ammunition for automatic weapons and the M1 rifle requires that every effort be made to conserve existing supplies and allow no waste or loss to occur.

■ 33. **SIGNAL COMMUNICATION.**—The term “signal communication” includes all means and methods employed to transmit messages. The agencies of signal communication ordinarily available to engineer units for combat include the message center, a limited wire system (telephone), and a messenger service. The engineer regiment (aviation) and the armored battalion have radio equipment in addition to these means. The engineers with cavalry units and triangular infantry divisions may be equipped with radio for special use on reconnaissance and distant missions. The facilities used by troops of other arms not available to engineer units are radio, panels, pigeons, pyrotechnics, telegraph, and signal lamps.

a. Regimental signal agencies.—Engineer regiments other than aviation establish wire communication from the regimental command post to the battalion command posts or to an advanced message center located as near as possible to the command posts of the battalions. An engineer unit with a brigade or division has wire communication established to the unit command post by brigade or division signal personnel. The regiment establishes a messenger service of motorcyclists, automobile messengers, or runners, as conditions warrant, from the regimental command post to the command posts of its battalions, attached units, adjacent regiments, to the division command post or to the unit to which attached, to the regimental rear echelon, and to supporting units.

b. Battalion and squadron signal agencies.—The regiment establishes wire communications to the battalions whenever possible. Wire communications from battalions to lower units is not organically available except in divisional battalions and squadrons which have equipment similar to the combat regiment with the square division (see T/BA 5). The battalion establishes a message center and a messenger service from the battalion command post to the command posts of the companies, adjacent battalions, attached units, supporting units, and the regiment or division command post.

c. Company signal agencies.—The first sergeant operates the company message center. Messenger communication is

established to the platoons, to adjacent companies, to supporting and attached units.

d. Reference.—Further information on the details of signal communication such as forms for messages, operations of message centers, and employment of the various means available to various units is given in FM 24-5.

■ 34. SECURITY.—*a.* Engineers must always provide local security for themselves at work, in combat, during independent movements, and may in unusual cases be called upon to furnish detachments for general security. Hence, the doctrine of security should be understood by all engineers (see FM 100-5 and 7-5).

b. When an engineer unit is engaged upon engineer work the leader of the unit takes steps for the security of his command. The types of enemy interference which must be particularly guarded against are enemy patrols which infiltrate past our own front line, motor or mechanized raids, and air attacks.

c. Protection against ground raids is obtained by detaching one or more patrols of from two men to a half squad each to circulate or take post in the vicinity of the work prepared to fire upon any enemies and to give warning of their strength and dispositions.

d. Protection against aerial activities is provided by detailing one or more pairs of observers posted at distant vantage points to give warning of approach of hostile aircraft. If it is believed that the work is being observed or photographed by the enemy, the leader causes his men to disperse and take cover. Low-flying airplanes may be driven off by rifle or machine-gun fire.

e. When it is known that the enemy uses poison gas, one or more sentinels properly trained in gas detection should be detailed to observe shell bursts and approaching clouds of smoke or gas, and to give warning by prearranged signals in order that the working troops may put on gas masks.

f. In stabilized situations, snipers may sometimes seriously interfere with engineer work and may stop it altogether. The best protection is to post sentinels in groups of two in advantageous positions to observe and try to discover location

of the snipers. One man then fires while the other observes through field glasses and reports results.

g. Spies may obtain employment with civilian groups doing work under engineer troop supervision. Engineers handling these groups should observe and report any person, whether a soldier or civilian, who shows unusual curiosity about the work or about troop activities in the vicinity, or is otherwise subject to suspicion.

h. Engineer troops engaged upon work at or near the front invariably keep their weapons nearby under guard. The leader determines upon a plan of action in case of enemy interference and in large units this plan may be published in an order. In rear areas where enemy interference is improbable, arms may be kept in camp or barracks while the troops are engaged upon engineer work, although some automatic weapons should always be provided for warning uses and for antiaircraft defense.

i. When engaged in subterranean mining operations, listeners are posted to discover evidence of similar enemy operations. Flank galleries may be driven to permit listeners to protect the main gallery from countermining activity. When discovered, enemy underground structures are destroyed by camouflages. See FM 5-25 for details of such operations.

j. In the unusual case when an engineer unit is furnishing advance, flank, or rear guards, the formations prescribed for infantry in similar circumstances are adopted. Engineers may have to furnish outposts for their own bivouacs in which case the outpost doctrines for infantry apply with the obvious limitations imposed by the different organization and equipment of engineer units.

k. Commanders of engineer units and trains take steps to protect their columns when on the march in unfriendly territory. The fundamentals of march security apply and where personnel of the unit are insufficient to furnish protection demanded by conditions the commander applies to higher authority for assistance from other troops.

l. In addition to security against enemy activity, it is a general rule that all engineer commanders take measures to guard all equipment and stores in their possession against theft and vandalism.

m. In case of very important construction, specific requests should be made for higher authority to provide necessary protective measures such as antiaircraft artillery, antitank units, other organizations, or engineers to erect and defend obstacles and barriers where there is danger of mechanized ground attack, or other troops to guard against local raiding parties of the enemy. Engineers will seldom have the means to provide all these security measures, but they should not fail to request whatever means are necessary.

CHAPTER 2

ENGINEERS WITH INFANTRY UNITS

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II. Combat regiment, square division.....	41-48
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SECTION I

COMBAT BATTALION

■ 35. GENERAL.—*a.* The combat battalion is the engineer component of the triangular infantry division, and normally performs the general engineer work for the division when the division is operating as a part of a corps. The combat battalion will often be reinforced when the division acts independently, and may be reinforced as required when the division operates with larger units.

b. Figure 10 shows the organization of the battalion. For details and Tables of Organization, see tables II, to V, inclusive, appendix II.

c. Engineer tools and equipment include a motorized power earth auger, motorized air compressors with tools, medium-powered tractors with bulldozers, a portable electric lighting set for division headquarters, water supply sets including portable water purification units, gasoline motor-driven pavement breakers and chain saws, assault boats, and sets of blacksmith, carpenter, demolition, pioneer, drafting and duplicating, sketching, surveying, sign-painting, pipe-fitting, welding and cutting, tinsmith, supplementary, and infantry intrenching equipment.

d. Transportation is sufficient to carry all personnel and material. It includes 1½-ton dump trucks for hauling personnel, equipment, work parties, and supplies; 1-ton trailers for hauling equipment and supplies; heavy cargo trucks with trailers to carry the tractors; ½-ton trucks for command, reconnaissance, and inspection purposes; and motorcycles for messenger service.

e. Armament consists of rifles, bayonets, caliber .30 heavy machine guns, and pistols. The battalion is trained for combat as infantry (see pars. 20b and 29).

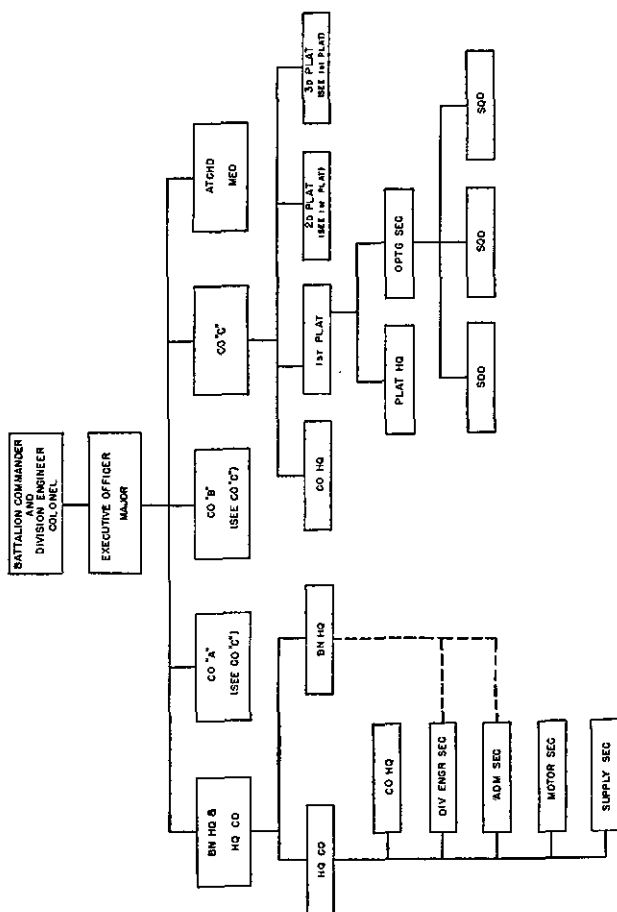


FIGURE 10.—Engineer battalion, combat, triangular division (T/O 5-75).

f. The combat battalion commander is the division (unit) engineer. He also commands any additional engineer troops attached to the division.

■ 36. PLATOON.—*a. Organization.*—The platoon of the combat battalion consists of a headquarters and an operating section (see table II, appendix II). Functions of the different elements of the platoon are as follows:

(1) The lieutenant in command of the platoon conducts necessary reconnaissances, plans work of the platoon, initiates supply arrangements, assigns tasks, and exercises general supervision. The platoon sergeant (staff sergeant) assists the platoon leader in these functions and exercises detailed supervision of the work. The corporal and privates of platoon headquarters operate the transportation assigned to platoon headquarters, and care for, transport, and issue platoon tools.

(2) The operating section performs the principal tasks assigned the platoon. The operating units (or squads) may be assigned separate tasks under their squad leaders, or may work together under the platoon sergeant or the senior squad leader. A squad can be broken up into two groups under the squad leader and the assistant squad leader. The normal work party is one squad with necessary tools, all transported on one dump truck. Supervision of work of the squad is the normal duty of the squad leader, but he will assist in the actual performance of work when necessary and when this does not detract from proper supervision of the work. Operating section personnel operate and care for transportation and equipment assigned to the section.

b. Operations.—(1) The platoon constitutes a highly mobile unit for executing general engineer work of the following classes:

(a) *Digging.*—Pioneer sets contain picks and shovels. The gasoline hammer has clay diggers and pavement breakers.

(b) *Clearing.*—Pioneer sets contain axes, machetes, etc. The gasoline chain saw fells trees.

(c) *Rigging.*—Pioneer sets contain tackle for erection purposes and handling heavy loads, etc.

(d) *Carpentry.*—Pioneer and carpenter sets contain tools sufficient for work by entire operating section on rough carpentry. The gasoline chain saw can be used to saw large timbers.

(e) *Demolitions*.—Demolition sets can equip several demolition parties; four using the electric exploder, the others using time fuse. The gasoline hammer has rock drills and pavement breakers.

(f) *Wrecking*.—Pioneer sets contain pinch bars, sledges, etc., suitable for small wrecking operations.

(2) The platoon normally is employed on one or more engineer tasks of the following nature:

(a) *Road repair and maintenance*.—Filling mine craters, shell holes, and chuckholes; providing or improving drainage ditches; placing or constructing culverts, and hauling and placing road metal.

(b) *Fixed bridges*.—Constructing standard wooden trestle and portable bridges; constructing temporary bridges from materials locally available, making full use of expedients; reinforcing existing bridges to take division loads; and erecting standard portable steel bridge.

(c) *River crossings*.—Constructing footbridges and operating assault boats. It may assist in construction of ponton bridges.

(d) *Field fortifications*.—Digging and revetting trenches, weapon emplacements, etc.; constructing obstacles of all kinds; laying antitank mine fields. Such work ordinarily is limited to work for the division as a whole, or to technical work which occupying troops are unable to do, or to rearward defensive positions.

(e) *Barriers and demolitions*.—Destroying bridges and culverts; creating mine craters; preparing tank traps, etc.

(f) *Assisting advance of our troops*.—Removing enemy obstacles such as mine fields, traps, and wire entanglements.

(3) The platoon may be reinforced with equipment and specialists from higher echelons. It then can perform additional work, or tasks for which its organic equipment is unsuited.

(4) The platoon is armed with the rifles and machine guns. It may furnish security for other engineers at work, in bivouac, etc., or may be used with other units of its battalion in infantry combat.

c. *Training*.—(1) Platoon personnel are trained in use and transportation of hand and mechanical tools, and maintenance of transportation.

(2) For basic, technical, and tactical training see sections V and VI, chapter 1.

■ **37. COMPANY.**—*a. Organization.*—The company of the combat battalion consists of a company headquarters and three platoons (see table III, appendix II). Functions of company headquarters personnel are as described in paragraph 12*a*.

b. Operations.—(1) The company is the smallest unit equipped to sustain itself in the field and is therefore the smallest unit normally assigned an independent mission.

(2) Company headquarters normally operates as one group, but may be separated into forward and rear echelons. In combat the captain, first sergeant, and messengers may form the forward echelon; other personnel and transportation form the rear echelon. The company commander determines composition and disposition of forward and rear echelons.

(3) The company commander divides the work assigned the company into platoon tasks preferably keeping platoons intact. He may assign company headquarters personnel and equipment to assist the platoons. He must—

(*a*) Analyze work and divide it into tasks.

(*b*) Supervise execution of the work, seeing that correct methods are used, that supply of material is maintained, that difficulties are anticipated and provided for, and that platoons are given all facilities possible in execution of their work.

(*c*) Train his company in all its functions.

(*d*) Lead his company in combat.

(4) The engineer work done by the company is in general of the same nature as that done by the platoon. Company headquarters can furnish additional assistance to platoons as follows:

(*a*) *Tractor with bulldozer.*—Used on roadwork, to move heavy objects, to pull trucks out of mudholes, etc.

(*b*) *Air compressor, motorized.*—Used in many types of work such as digging, clearing, carpentry, wrecking, and demolitions, with the following pneumatic tools: pavement breakers, rock drills, clay diggers, wood-boring machine, circular saw, and chain saw.

(*c*) *Blacksmith set.*—Used to provide minor ironwork required for bridge and general construction, to sharpen and

repair shovels, picks, etc., and to assist in maintenance of vehicles.

(d) *Carpenter and wheelwright set.*—Provides additional tools, principally for finer carpentry work.

(e) *Sign-painting set.*—Used as name implies.

(f) *Drafting and duplicating set; sketching set.*—Used to prepare and reproduce sketch maps and field drawings for distribution to company personnel.

(g) *Additional personnel.*—Company headquarters can, in emergency, furnish a few men to platoons to provide additional workers. It can also furnish cooking equipment and a cook for a platoon on a detached mission.

(h) *Transportation.*—Company headquarters vehicles may supplement platoon vehicles in supplying platoons or in the engineer operations of the platoons. Company headquarters personnel assist platoons in motor repair.

(i) *Engineer reconnaissance and supply.*—These are major engineer functions of company headquarters. Platoons are left free for work. Reconnaissance reports are submitted to battalion headquarters, particularly locations and quantities of local supplies. Platoon trucks not needed for platoon work may be used for company supply operations.

(j) *Mess and routine supply.*—Company headquarters normally does all work in connection with the mess and routine supply of the platoons.

(5) In combat, the operations of the company are similar to the infantry rifle company. The engineer company however has less fire power than the infantry company, particularly in supporting weapons, and less training in infantry combat.

c. *Training.*—(1) In company headquarters, certain individuals are trained in use of special engineer equipment. Company headquarters is best trained by employing the company on the various tasks and operations which it may carry on in war.

(2) The company commander is responsible for the training of his company as individuals, as a group of working units, and as a company unit.

(3) Training in close-order drill as a company unit is obtained by company drill and participation in battalion ceremonies.

(4) Training in tactics is obtained by combat exercises by the company alone and with the battalion. The company trains in those maneuvers most likely to be needed for their own security while at work and in their use as reserves to reinforce or relieve infantry units.

(5) Long periods must be assigned for training in engineer tasks, simulating war conditions.

(a) In moving to and from locations of engineer tasks practice march formations.

(b) The company is trained to operate as a detached unit.

(c) The company is trained primarily to work by platoon.

(d) The work required of combat engineers is varied so that a large amount of time cannot be spent on one class of work to the exclusion of other classes.

(e) In company training, engineer work is preceded by engineer reconnaissance, estimates are made, tasks are assigned platoons, and engineer supply is provided for during the drill period.

■ 38. BATTALION HEADQUARTERS AND HEADQUARTERS COMPANY.—

a. Organization.—Battalion headquarters and headquarters company of a combat battalion are organized and equipped as shown in table IV, appendix II.

b. Operations.—(1) The battalion staff in war operates like the staff of a regiment (see par. 10b) except that separate intelligence and operations officers are not provided, and the commanding officer of headquarters company is also the battalion supply officer. No chaplain is provided.

(2) Duties of the headquarters company are—

(a) *Company headquarters* operates its transportation and takes care of administration and routine supply of the company. It provides messing facilities for battalion headquarters and headquarters company.

(b) *Division engineer, administrative, and supply sections* furnish personnel for staff sections of battalion headquarters. The supply section operates the water supply equipment, portable gasoline motor-driven purification units, and power earth auger. It transports and cares for tools and equipment assigned to the section.

(c) *Motor section* operates electric lighting set. It repairs motor transportation beyond the capability of the operating

units. Part or all battalion transportation may be pooled under the motor section for operations under battalion control if necessary.

(3) In some situations, particularly when the battalion acts as infantry or is on engineer work close to the front lines, it is desirable to split the headquarters into forward and rear echelons. The composition of each echelon is decided by the battalion commander to fit the particular situation. Normally the forward echelon consists of the battalion commander and executive officer with part of the division engineer section; the balance of the headquarters forms the rear echelon under S-4.

c. *Training.*—See section V, chapter 1.

■ 39. ATTACHED MEDICAL.—The medical detachment consists of 3 officers and 11 enlisted men. It has one 1½-ton cargo truck and one ½-ton command truck for carrying personnel and medical supplies.

■ 40. EMPLOYMENT.—a. (1) More important duties which the battalion may perform for its division are—

(a) Removal and passage of enemy obstacles, mine fields, and road blocks.

(b) Demolitions and construction and defense of obstacles, mine fields, and road blocks.

(c) River crossing operations, operation of assault boats, preparation of fords, and construction of vehicle ferries, portable bridges, and ponton bridges for light and medium loads.

(d) Emergency repair of roads and reinforcement and repair of bridges.

(2) Less important duties are—

(a) Rapid general lay-out of rear positions, marking routes, and guiding units to sectors.

(b) Construction of fixed bridges and roads.

(c) Construction of advanced landing fields.

(d) Local defense of engineer working parties.

(e) Combat as infantry.

b. Duties performed by specialists or small groups within the battalion for its division are—

(1) Engineer supply of tools and equipment.

(2) Engineer reconnaissance.

(3) Water supply.

(4) Providing electric lights for division headquarters.

(5) Map supply.

(6) Marking routes and furnishing guides.

(7) Camouflage inspection and supply of camouflage materials.

(8) In a stabilized situation construction of more elaborate defensive installations requiring use of special engineer equipment.

c. Battalion headquarters divides the engineer work in the division area among the companies by making either area or task assignments, or combinations thereof. In area assignments, each unit is given all the engineer work in a part of the division area; in task assignments, each engineer unit is assigned a definite task. In either case an engineer unit may support other organizations such as a regimental combat team by assisting its supply and movement. Normally the battalion operates as a unit under control of the battalion commander. In some cases, usually when lack of rapid communication makes direct control difficult, companies or platoons may be attached to infantry regiments or other parts of the division. When such attachments are repeatedly necessary, it is best to attach the same engineer unit to the same infantry or other unit in order to take advantage of the favorable liaison command relationship established between the two units.

d. The major items of engineer supply which the battalion handles for the division are barbed wire, sandbags, and intrenching tools for field fortifications; camouflage materials; maps and map substitutes; and materials such as road metal, bridge timbers, and explosives needed for engineer work. Stocks of materials normally carried by the battalion are very small and are limited mostly to explosives, intrenching tools, and field-fortification supplies. The division engineer must anticipate engineer supply needs in each situation and secure stocks from the corps or army to supplement those available locally. The battalion has very limited map-reproduction facilities. Maps and map substitutes are procured from the corps or army engineers.

e. In infantry combat, the battalion is used as a unit rather than attached piecemeal. It may be attached as a unit to an

infantry regiment. While its combat operations are comparable to those of the infantry rifle battalion (less heavy weapons company), its fire power is less than that of the infantry battalion because of comparative lack of supporting weapons. See section III.

SECTION II

COMBAT REGIMENT, SQUARE DIVISION

■ 41. **GENERAL.**—*a.* The combat regiment is the engineer component of the square infantry division, and performs the normal general engineer work for the division whether the division is operating independently or as part of a corps. In situations requiring unusual amounts of engineer work the regiment is reinforced, or corps engineers take over certain work in the division area.

b. Organization of the regiment is shown in figure 11. For details and Tables of Organization see tables VI to IX, inclusive, appendix II.

c. Engineer tools and equipment are similar to those of the combat battalion.

d. Transportation is sufficient to carry all personnel and material. Types of transportation are the same as for the combat battalion.

e. Armament is similar to that of the combat battalion. The regiment is trained for combat as infantry (see pars. 20*b* and 29).

f. The combat regimental commander is the division (unit) engineer. He commands any additional engineer troops attached to the division.

■ 42. **PLATOON.**—The platoon of a combat regiment is identical to the platoon of a combat battalion with respect to organization, operations, and training (see par. 36 and table II, app. II).

■ 43. **COMPANY.**—The company of a combat regiment is essentially the same as the company of the combat battalion with respect to organization, operations, and training (see par. 37 and table III, app. II), except that it has only two platoons instead of three.

■ 44. BATTALION.—*a. Organization.*—The battalion of a combat regiment consists of a battalion headquarters and three companies, organized and equipped as shown in table VII, appendix II. Battalion headquarters contains only com-

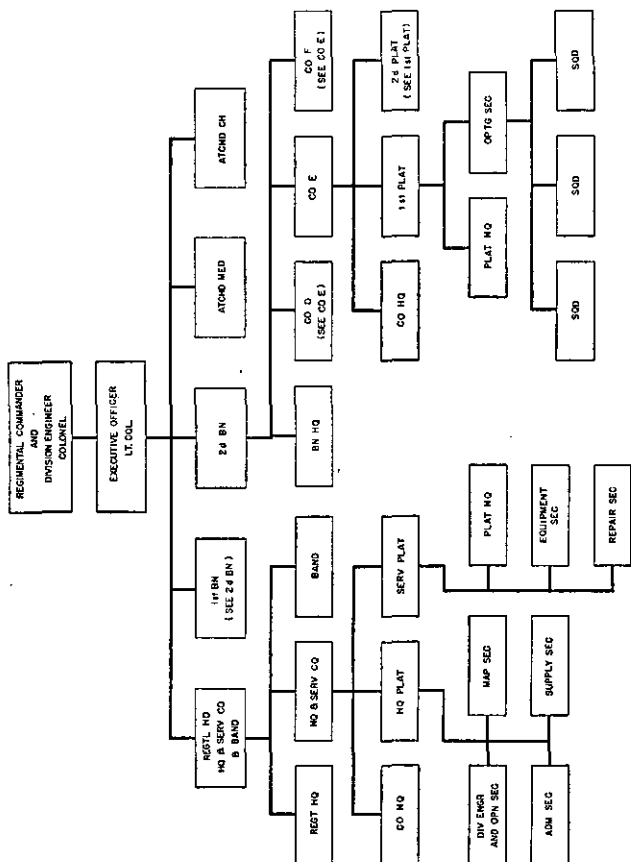


FIGURE 11.—Engineer regiment, combat, square division (T/O 5-11).

mand personnel. It has no organic engineer equipment and no transportation, except that one ½-ton command truck in the regimental headquarters and service company is normally reserved for use of each battalion headquarters.

b. Operations.—The battalion has neither personnel nor equipment for administration or supply. It organizes and controls engineer work generally as prescribed in paragraph 40c and it engages in combat as prescribed in paragraph 40e for the combat battalion of the triangular division. The battalion can operate separately if it is provided with headquarters and medical detachments and additional battalion staff officers.

c. Training.—Battalion headquarters must be trained in issuing orders, in planning battalion operations, in properly distributing work to companies, in handling combined transportation, and in inspecting and supervising engineer work. The battalion is trained as a unit in rapid and orderly organization for engineer work. For basic and combat training see sections V and VI, chapter 1.

■ 45. REGIMENTAL HEADQUARTERS, AND HEADQUARTERS AND SERVICE COMPANY.—Regimental headquarters and the headquarters and service company of a combat regiment are organized and equipped as shown in table VIII, appendix II. They operate as described in paragraphs 10 *b* and *c*. The headquarters and service company contains personnel and equipment for mess and routine supply of all headquarters personnel. For training see sections V and VI, chapter 1.

■ 46. BAND.—The band of the combat regiment consists of a warrant officer and 28 enlisted men. Its mess, routine supply, and transportation are provided by headquarters and service company (see par. 10*d*).

■ 47. ATTACHED MEDICAL.—The medical detachment with the combat regiment consists of 6 officers and 38 enlisted men with one ½-ton command truck and three 1½-ton cargo trucks. For combat operations, the detachment normally is divided into a headquarters section and two battalion sections of one officer, 12 men, and one truck each (see par. 13).

■ 48. EMPLOYMENT.—*a.* General organization and major equipment of the combat regiment are shown in tables VI to IX, inclusive, appendix II.

b. Employment of the combat regiment follows the same lines described in paragraph 40 for the combat battalion with minor exceptions:

(1) The combat regiment normally constructs ponton bridges without being reinforced by other engineer troops.

(2) The combat regiment has reproduction equipment capable of reproducing overprints, overlays, and sketches in limited quantities.

c. For details of operations of the combat regiment as divisional engineers in various types of tactical situations, see section III.

SECTION III

OPERATIONS

■ 49. GENERAL.—Operations of engineers organically assigned to a division vary according to the type of military operation in which the division engages. The following paragraphs describe operations of divisional engineers in various situations and apply to the combat battalion, combat regiment, and squadron, or to any engineer unit assigned work in support of a division. The fundamental tactical situations in which these duties predominate are discussed in FM 100-5.

■ 50. ADVANCE.—*a. Duties.*—In an advance the division engineers are chiefly employed as indicated in paragraph 263.

b. Strength and position in column.—Engineer troops when available are used invariably with the advance guard of a column. The usual allotment varies from a platoon to a company. In addition to engineers with the advance guard, the main body of a column may include other engineers. From information obtained from maps, aerial photographs, and covering forces, a fairly accurate forecast of engineer work can be made. This estimate and consideration of work to be done by engineers at the end of the day's march determines strength of engineers with the advance guard and with the main body, and position of engineers in the column. The division engineer recommends the number of engineers to be included in each column; these engineers are attached to columns by order of the division commander. The column commander then attaches to his advance guard such of these engineers as may be required. Engineers in the advance

guard are accompanied by their tools. Where streams are to be crossed, bridge equipment accompanies engineers of the advance guard.

c. Command.—Engineers with an advance guard are under orders of the advance guard commander. The engineer commander in such a case makes timely recommendations to the advance guard commander for employment of the engineers.

d. Execution of work.—Engineers should have representatives with the most advanced elements of the advance guard to give timely warning of engineering work required. The advance guard engineers leave work details at vital points where need for engineer assistance exists or can be foreseen. These details may rejoin their unit on completing their task, but ordinarily need for continuous maintenance of these vital points will prevent this until the column has passed. Thus the advance guard engineers may become depleted and by the end of the march may be strung out along the roads at a number of points. The details are picked up by trucks and returned to their organization when the column has passed. It may be necessary therefore to renew the strength of the advance guard engineers by attaching a new unit during the march, this unit being brought up in motors.

e. Security.—Security for engineers in march column is ordinarily provided by the infantry, but the leader of engineer troops engaged on work assures himself that such security is provided. He disposes his own forces so that security is maintained and so that his men have ready access to their arms in case of attack.

f. Additional troops.—When work essential to the advance is beyond capacity of advance guard engineers to perform, they are assisted by troops of other arms. The additional troops work under their own leaders with engineer advice, or under engineer control.

g. Reconnaissance.—Continuous engineer reconnaissance is maintained during an advance and periodic and special reports of the results are made to the next higher engineer echelons in accordance with the reconnaissance plan.

h. Employment.—(1) *Platoon.*—A platoon used with the advance guard can only make minor repairs, remove simple obstructions, and make a limited engineer reconnaissance.

(2) *Company*.—A company with the advance guard can provide maintenance personnel for duty at critical points encountered during an ordinary day's march. For long marches over poor roads more than one company may be needed. Company trucks are kept available for engineer supply of the company.

(3) *Division engineer*.—The division engineer must be constantly available to the division commander for consultation concerning engineering features of the advance. He usually will leave actual conduct of operations of his unit to his executive officer. He maintains liaison with the advance guard engineers and other engineers attached to march columns. If their strength is unduly depleted by detachments for engineer work, he recommends to the division commander the attachment of additional engineer troops to the advance guard. He keeps informed of the results of engineer reconnaissance by the advance engineer elements.

■ 51. RETIREMENT OR WITHDRAWAL.—*a. Duties*.—In a retirement or withdrawal some engineer troops are employed near heads of retiring columns on duties similar to those described in paragraph 50 for an advance and others are needed at rear of columns for delaying operations. See paragraph 264 for duties and dispositions.

b. Demolitions (see par. 3*d* (4)).—Demolitions of important bridges or other structures generally are prescribed or authorized by the commander of the forces. When it is known that a bridge is to be destroyed the man on the ground is often the best judge of the proper time to destroy it. Engineer officers in charge of bridge demolitions must be thoroughly familiar with the situation, know the plan of the commander of the forces, and execute demolitions in accordance therewith. Liaison with friendly bodies of troops between the enemy and the line of demolitions is extremely important in order to set up routes for their withdrawal. Demolitions are executed as early as possible consistent with such withdrawal. Demolitions will be endangered by waiting for stragglers or small delayed bodies to cross.

c. Employment.—Engineer duties vary within wide limits. Some of the duties which platoons and companies may perform are—

(1) *Platoon.*—(a) *With leading troops.*—Normally assists movement of the main body by repairing roads and bridges. It may place demolition charges which will be executed on order of rear guard engineers acting under instructions of the covering force commander concerned. In such case it leaves a guard for each charge placed.

(b) *With rear guard.*—Usually executes demolitions and creates barriers and obstacles. For demolitions it may only fire charges already placed; it may execute successive demolitions along a route of retreat, operating in two echelons, a charging party and a firing party; or it may execute simultaneous demolitions along a line crossing the route of retreat, operating by squads or sections with each such unit doing both charging and firing.

(2) *Company.*—(a) *With leading troops.*—Mission is generally to repair roads and bridges and leave detachments for maintenance thereof. As the column retreats these detachments may be picked up and returned to their unit, or may augment rear guard engineers.

(b) *With rear guard.*—Mission is generally to execute demolitions and create barriers and obstacles. The company moves by bounds and echelons.

d. *Attached ponton units.*—Ponton bridge units if available precede the movement in order to be available for placing any ponton bridges required. Ponton bridges remain in position until main bodies have crossed. If used by covering force equipment may be lost. Therefore the decision as to time for removing floating bridges rests with the commander of the main force or the major combat team commanders comprising the various divisional columns. Timely recommendations concerning technical questions relating to removal of bridges and ferrying operations are made by the division engineer, or the engineers with the major combat teams.

e. *Division engineer.*—The most important duty of the division engineer in a retirement is to put into force an adequate engineer plan which insures that roads over which the division retires are kept passable, and that the enemy is

impeded by a thorough and systematic blocking of every route by which he can approach flanks or rear of the division.

■ 52. **ATTACK.**—*a. Duties.*—In preparation for and during an attack divisional engineers are employed as indicated in paragraph 265.

b. Preparations.—Prior to an attack dumps of engineer material are established, especially of road material to be used immediately following the first phases of the attack. Where streams, gullies, etc., must be crossed, the portable H-10 steel bridge or bridge-building material is concentrated both for initial crossing of foot troops and for crossing artillery and trains of the division.

c. Consolidating new position.—If the attack is halted the engineers may be used in consolidating the new positions. This requires construction of certain field fortification works such as tank obstacles, barriers, and command and observation posts, and provision of tools and materials for the infantry. Relocation of engineer dumps, opening water supply facilities, and placing direction signs may be required.

d. Pursuit.—In pursuit of the enemy following a successful attack, duties of engineers accompanying the encircling force or forces are similar to those described for engineers in an advance but far more exacting as speed of movement is all important. Employment of divisional engineer troops upon a pursuit mission may involve temporary abandonment of important engineer work for the direct pressure force or the force as a whole, but this may be justified by the greater necessity of cutting off the retreating enemy and destroying him. Only motorized engineers under resourceful leadership should be assigned to an encircling force.

e. Employment.—(1) *Platoon.*—The platoon may be attached to a combat unit such as a battalion of infantry or to a combat team. The platoon leader works in close cooperation with the commander of the unit or team to which attached. The platoon transportation is kept available to the platoon. Usually, however, the platoon is not attached but will be assigned some engineer task by the company commander.

(2) *Company.*—The company is usually employed upon improvement of routes of communication. The amount of work

that the company can do with its men and tools alone is relatively small. It is generally necessary that special material be procured and prepared in advance, and that arrangements be made for supply of this material to the working units. The company is given a definite mission.

(3) *Battalion of combat regiment.*—The battalion may be assigned either a definite task, general engineer work within a given area, or combination of both. When necessary units from one battalion may be attached temporarily to the other.

(4) *Division engineer.*—The division engineer's command post is at his unit headquarters. He maintains contact with division headquarters and with all engineering operations within the division area. He transmits technical reports directly to the corps engineer, informing him of the engineering features of the attack. He revises the engineer plan when necessary for a continued compliance with the engineer mission. When needed, the division engineer requests additional troops and from time to time arranges with the corps engineer to relieve the division engineer troops of road maintenance and other tasks as far forward as practicable.

■ 53. DEFENSE AND DELAYING ACTION.—*a. Duties.*—Duties of engineers in defensive and in delaying actions are covered in par. 267.

b. Employment.—(1) A company or platoon assigned to a tactical unit in defense normally is employed upon improvement of routes of communication; execution of demolitions, obstacles, mine fields, and road blocks for the unit as a whole; execution of defensive works requiring technical skill or special tools; or preparation and supply of material to be used in field fortifications such as revetment, trench accessories, and wire. When a company is assigned to the layout of a rear position, contact is made with tactical commanders who will occupy the new position. Signs indicating the position are provided and guides furnished. Platoon transportation is kept available to the platoons.

(2) Battalions in the combat regiment are assigned tasks as in attack (see par 52e (3)).

(3) The division engineer maintains his headquarters in close proximity to that of the division commander. He

makes a careful reconnaissance of new defensive positions in rear and prepares a plan for their organization should a withdrawal be directed by the commander. He makes visits to the subordinate echelons of his own command and visits the command posts of other units to assure himself that engineers are furnishing assistance required by fighting troops. He pays particular attention to supply to troops of all arms, tools, and materials which are needed to increase defensive strength of the position. He has a map of the sector prepared and kept up to date. He maintains liaison with the division engineers of adjacent divisions and with the corps engineer.

■ 54. RIVER CROSSING.—*General.*—Since river crossings are special tactical operations particularly relying on engineer technique, they are discussed in detail in section II, chapter 13, of this manual, and in FM 5-270.

■ 55. REST AREA.—*a.* When a division is in a rest area, the engineers of the division conduct their training and recuperation activities in accordance with the general programs and directives of the division commander. In addition, they may be employed upon engineering work of a nature to increase comfort and improve morale of the division troops such as—

- (1) Repairing billets, mess halls, and recreational structures.

- (2) Constructing target ranges.

- (3) Improving water supply.

- (4) Operating utilities.

- (5) Maintaining roads in the area.

b. If necessary to assure that the engineer unit is receiving necessary rest and opportunity for reorganization, work details from other arms should be requested.

c. Troops occupying a given rest area change from time to time. In order to maintain a continuity of engineering policy within the area, the unit engineer keeps a file of pertinent information to turn over to his successor. This includes approved construction projects and plans, an inventory of engineer supplies and their location, condition and needs of operating and maintenance projects (see par. 272).

CHAPTER 3

ENGINEERS WITH CAVALRY AND ARMORED UNITS

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SECTION I

SQUADRON, CAVALRY DIVISION

■ 56. **GENERAL.**—*a.* The engineer squadron is the engineer component of the cavalry division (horse), and performs normal engineer work for the division.

b. Organization of the squadron is shown in figure 12. For details and Tables of Organization see tables X and XI, appendix II.

c. The squadron is similar in general to the combat battalion in equipment, transportation, and armament. It contains transportation for all personnel, equipment, and a limited stock of supplies.

d. The squadron commander is the division engineer. He also commands any additional engineer troops attached to the division.

■ 57. **PLATOON.**—The platoon of the engineer squadron is identical in organization, equipment, and operations to the platoon of the combat battalion (see table II, app. II, and par. 36). Because of the special nature of engineer work with the cavalry division, however, special emphasis in training should be placed on the following classes of engineer operations:

a. Independent operations of small groups detached from the platoon.

b. Antimechanized defense by rapid demolitions and installation of obstacles.

c. Engineer reconnaissance particularly covering engineer information of value to higher echelons under which the cavalry division is operating.

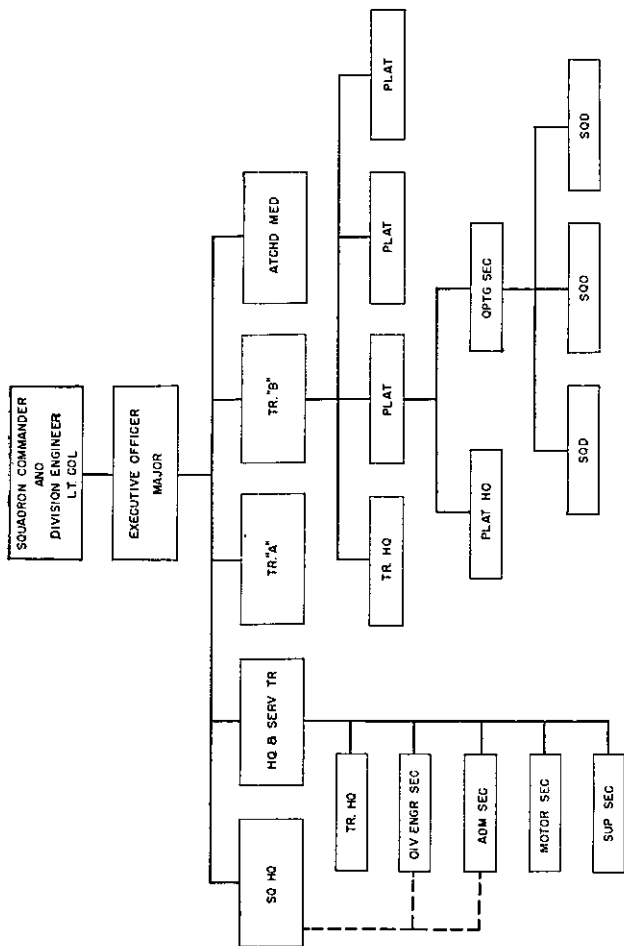


FIGURE 12.—Engineer squadron (T/O 5-115).

■ 58. TROOP.—The troop of the engineer squadron is identical in organization, equipment, and operations to the company of the combat battalion (see table III, app. II, and par. 37).

■ 59. SQUADRON HEADQUARTERS, AND HEADQUARTERS AND SERVICE TROOP.—Squadron headquarters, and the headquarters and service troop of the engineer squadron are organized, armed, and equipped as shown in table X, appendix II. Its operations are similar to those of the battalion headquarters and headquarters company of the combat battalion (see par. 38).

■ 60. SQUADRON.—*a.* Organization, major engineer equipment, and armament of the engineer squadron are given in table XI, appendix II.

b. Employment of the squadron on engineer work follows the procedure described in paragraph 40 for the combat battalion. Since the horse cavalry division is capable of reconnoitering a zone 30 miles wide to the depth of 20 miles per day, the engineer squadron may have to conduct engineer reconnaissance of roads and other important localities over a very extensive area each day.

c. Engineers with cavalry will be used as combat troops only in emergencies. When necessary to employ the squadron in combat, its size, fire power, and mobility should be considered carefully by the division commander. Engineers with cavalry must also be prepared to take combat action on their own initiative in self-defense or whenever such action is necessary in order to accomplish an engineer mission. Dismounted combat action for engineers with cavalry is conducted in accordance with the doctrine for infantry combat.

d. Section III, chapter 2, also applies to operations of the squadron in most tactical situations. While these operations are generally similar to those of the combat battalion with the triangular division, the mobility of cavalry and the rapidly changing situation call for a high degree of ingenuity and resourcefulness, particularly by commanders of subordinate engineer units. The cavalry horse unit can often negotiate or circumvent obstacles without aid. Mechanized and motorized units will frequently need engineer assistance but this will normally be in the form of expedients to pass the column over obstacles rather than erection of structures to carry

heavy and continuous two-way traffic. Ordinarily engineers are attached to mechanized units for prompt engineer reconnaissance or for effecting demolitions and erecting obstacles. With a cavalry division in pursuit the principal engineer effort is made with the advance cavalry forces to assist their rapid movement and to disrupt or destroy the hostile routes of retirement by flank operations.

SECTION II

BATTALION, ARMORED DIVISION

■ 61. GENERAL.—*a. Mission.*—The engineer battalion, armored division, is a part of the combat echelon of the armored division. Its principal mission is to facilitate movement of the division and to impede hostile ground forces, particularly armored units attacking or interfering with operations of the armored division. In facilitating movement of the division, the primary demand upon the battalion will be that of providing crossings, either by reinforcement of existing crossings or their rapid replacement by fixed or floating bridges from equipment organically assigned to and transported by the battalion. The critical load is the medium tank weighing approximately 27 tons.

b. Assignment.—An engineer battalion, armored division, probably will be assigned as part of the corps troops of the armored corps in addition to an engineer aviation regiment; an engineer combat regiment (corps); a topographic battalion; a heavy ponton battalion; and a corps engineer headquarters.

c. Organization.—The battalion consists of a headquarters, a headquarters company, three lettered companies, and a bridge company as shown in figure 13 and table XII, appendix II.

d. Equipment.—The engineer equipment other than that of the bridge company corresponds generally to that of the combat battalion. Specialized equipment of the bridge company is listed in table XIV, appendix II.

e. Transportation.—Most of the personnel is transported in 13-passenger, half-track, personnel carriers. The battalion is provided with $\frac{1}{2}$ -ton command cars, motorcycles,

and scout cars for command, messenger, and reconnaissance purposes. In addition, the battalion is provided with $\frac{1}{2}$ -ton weapon carrier trucks, half-track cars, various types of cargo

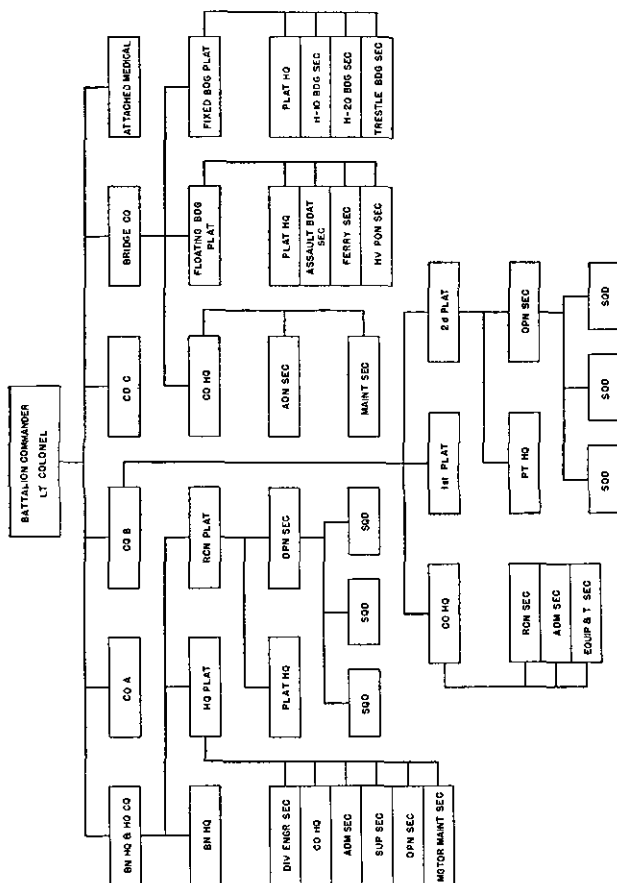


FIGURE 13.—Engineer battalion, armored division (T/O 5-215).

trucks, and special trucks and trailers for the bridge company.

f. Armament.—The battalion is armed with caliber .50 and heavy and light caliber .30 machine guns, submachine guns,

rifles, and pistols. Armament of the scout cars and of half-track cars consists of two heavy caliber .30 machine guns, one caliber .50 machine gun and one submachine gun. Armament of the half-track personnel carriers consists of one heavy caliber .30 machine gun and one submachine gun.

g. Communications.—Means of communication include 8 two-way radio sets and 14 motorcycles. Radios are assigned, one to each lettered company (in the engineer battalion net), and four to battalion headquarters and headquarters company, of which one is assigned to the battalion commander and division engineer (in division command net), one to the battalion executive (in the engineer battalion net), one to the command post of headquarters company (in the battalion net but makes scheduled contacts with the primary station in the division administrative net), and one to the reconnaissance platoon (in the battalion net). Motorcycles are especially valuable for speedy messenger service within a limited radius of travel and are indispensable for traffic control on the march.

h. Training.—Basic training is conducted as indicated in section V, chapter 1.

■ 62. PLATOON.—*a. Organization.*—Strength, armament, major engineer equipment, and transportation of the platoon are shown in table XIII, appendix II. It is organized into a platoon headquarters and an operating section of three squads similar to the platoon of the combat battalion (see par. 36).

b. Equipment and armament.—Equipment of the platoon is similar to that of the platoon of the combat battalion. In addition, supplies of explosives, antitank mines, and bridge reinforcing materials are carried in the personnel carriers not assigned to squads. Armament consists of rifles, pistols, and automatic weapons of the half-track personnel carriers.

c. Transportation.—The ½-ton command truck and the five half-track personnel carriers give the platoon the same cross-country mobility as the combat elements of the armored division.

d. Training.—For basic training, see paragraphs 20 to 23. Combat training of the platoon will parallel that of the

platoon of the support echelon (infantry regiment) of the armored division. The engineer training is similar to that of the platoon of the combat battalion (see par. 36). However, special emphasis is given to training in rapid construction of obstacles and preparation of antitank mine fields, in hasty repair, improvisation, and reinforcement of bridges and culverts, and in preparation of fords and ferrying expedients for crossing armored vehicles on a broad front. Structures erected must be capable of taking the load imposed by medium tanks, but their siting, revetment of their approaches, and measures taken to guard against the elements are secondary.

■ 63. COMPANY.—*a. Organization.*—The engineer company of the armored battalion consists of a company headquarters and two platoons (see table XIII, appendix II). Company headquarters is subdivided into an administrative section, a reconnaissance section, and an equipment and transportation section, whose functions are as implied by the names. The equipment and transportation section operates the motor vehicles and reinforcing equipment not otherwise assigned within the company and performs 2d echelon motor maintenance for the company. For equipment, armament, and transportation see table XIII, appendix II.

b. Training.—For training, see paragraphs 20 to 23 and 37. In addition to the engineer training ordinarily given to the engineer combat company, the training of the engineer company of the armored battalion in its duties as a member of the various armored combat teams is emphasized (see par. 66). The remarks made relative to the combat and engineer training of the platoon applies to the company.

c. Operations.—For routine administrative functions, see paragraph 12*a*. For technical employment, see paragraph 62*d*. Requirements for engineer work will frequently necessitate dispersion of the company over such a wide area that special provision will have to be made for messing such as by carrying reserve rations in containers on the vehicles. If the company cannot furnish these facilities, an alternative procedure will be to attach engineer units to nearby units for messing.

■ 64. **BRIDGE COMPANY.**—*a. General.*—The primary mission of the bridge company is to maintain and transport the stream-crossing equipment carried by the company. It furnishes trained personnel and power erection equipment to assist in the erection of its stream-crossing means. The bridges are erected by the armored companies or the reconnaissance platoon of the headquarters company. The bridge company maintains equipment after erection, furnishes bridge guards, and operates ferry units.

b. Organization.—The bridge company consists of a company headquarters, a floating bridge platoon and a fixed bridge platoon, organized, armed, and equipped as shown in table XIV, appendix II. The company headquarters is subdivided into an administrative section and a maintenance section. The floating bridge platoon is subdivided into a platoon headquarters, an assault boat section with 20 assault boats, a ferry section with two 30-ton ferry units, and a heavy ponton section with one unit (250 feet) of heavy ponton bridge. The fixed bridge platoon is subdivided into a platoon headquarters, an H-10 bridge section with 72 feet of H-10 bridge, an H-20 bridge section with 125 feet of H-20 bridge, and a trestle bridge section with 300 feet of portable trestle bridge.

c. Equipment.—For equipment see table XIV, appendix II. In addition to its stream-crossing equipment the company has special trucks such as crane trucks and a wrecker truck for operation and service of equipment.

d. Transportation.—The stream-crossing equipment and the personnel of the company are carried on trucks, trailers, and semitrailers of the company. Transportation of the company is shown in table XIV, appendix II.

■ 65. **BATTALION HEADQUARTERS AND HEADQUARTERS COMPANY** (see fig. 13 and table XV, appendix II).—*a. Battalion headquarters* consists of five officers, a lieutenant colonel who is battalion commander and division engineer; a major (battalion executive); and three captains (adjutant, S-2, and S-3). The duties of S-2 require special mention. Not only does he perform the normal duties of a unit S-2, but he coordinates engineer reconnaissance activities of the reconnaissance platoon of headquarters company and the

reconnaissance sections of the three armored companies. He is charged with reconnaissance planning and compilation, preparation, and dissemination of engineer reconnaissance information.

b. Headquarters company.—Consists of a headquarters platoon and a reconnaissance platoon organized, armed, and equipped as shown in table XV, appendix II.

(1) *Headquarters platoon.*—The headquarters platoon is divided into a company headquarters, a division engineer section, a supply section, an administrative section, an operations section, and a motor maintenance section. The operations section operates heavy equipment not assigned to companies and maintains radio and engineer equipment of the battalion except that which comes under motor maintenance. The remaining sections have duties similar to those of their counterparts in the combat battalion (see par. 38 b).

(2) *Reconnaissance platoon.*—This platoon consists of a platoon headquarters, two reconnaissance sections of four men each, and an operating section of three squads. It is normally attached to the division reconnaissance battalion where it performs the engineer work for the battalion and makes technical engineer reconnaissance for the reconnaissance battalion and for the division engineer. The reconnaissance platoon and the squads thereof are equipped with the same engineer tools, equipment, and supplies as the platoon of the armored company, and in addition has motorized air compressor equipment as shown in table XV, appendix II.

(3) *Training.*—The headquarters platoon is trained similarly to the headquarters company of the combat battalion, insofar as administrative, supply, motor maintenance, and company headquarters functions are concerned. However, the division engineer section operations must be modified to correspond with those developed for the special staff of the armored division. The primary training of the reconnaissance platoon is based on securing rapidly and accurately engineer information on which to base the engineer plan. Its training for signal communications, including radio, is of paramount importance. For basic training of the company, see section V, chapter 1. The headquarters company ordi-

narily will be dispersed so widely throughout the division that its use as a combat unit is unlikely. However, the personnel are trained in use of organic weapons, particularly automatic weapons, so as to be capable of fighting in small groups.

■ 66. EMPLOYMENT.—*a. General.*—The usual employment of the battalion as a part of the armored division is as follows:

(1) The normal engineer attachment to each of the two light armored (tank) regiments is at least a platoon of engineers plus a company reconnaissance section. In many cases, an entire engineer company is attached. This engineer component not only does engineer work of the regiment, but it carries out reconnaissance to obtain information of roads, strength of bridges, defiles, and obstacles for use of the regimental commander. It is also charged with making results of engineer reconnaissance known to the division engineer.

(2) The third engineer company may be attached in whole or in part to the medium armored (tank) regiment, to the infantry regiment, or it may operate under the engineer battalion commander.

(3) The bridge company will be in an assembly area or on the march in the rear part of the forward echelon of the division from where it can dispatch one or several of its components to the several companies of the battalion, as ordered by the battalion commander.

(4) The reconnaissance platoon of the battalion headquarters company is normally attached to the division reconnaissance battalion with twofold functions. It aids the battalion in overcoming obstacles and it obtains information on roads, bridges, defiles, and obstacles for use of the division and especially for use of the division engineer so that he can recommend wisely disposition of engineer means of the division and make plans for engineer work necessary to facilitate the advance. In combat and during approach to combat, the major engineer effort must be concentrated well forward to assure rapid movement of the combat forces.

(5) The battalion is capable of performing the following tasks for the division but not all at any one time:

(a) Make reconnaissance of routes, bridges, defiles, and obstacles.

- (b) Mark routes.
- (c) Establish water points.
- (d) Assist in security measures.
- (e) Reinforce existing bridges.
- (f) Provide electric current for division and brigade headquarters.
- (g) Prepare demolitions.
- (h) Construct obstacles.
- (i) Remove obstacles.
- (j) Reproduce sketches.
- (k) Bridge streams up to 250 feet wide with a ponton bridge that will carry all armored division loads.
- (l) Bridge streams or gulleys up to 125 feet wide with a fixed bridge that will carry all armored division loads.
- (m) Construct portable trestle bridges.
- (n) Ferry tanks and other elements across wide streams.
- (o) Move infantry elements across streams in assault boats.
- (p) Fight as infantry when required.

b. Improvement of routes of advance.—The armored division moves so rapidly and continuously while in forward areas that there is little opportunity for engineers to improve roads. Route improvement will consist primarily of filling shell holes, strengthening and construction of bridges, and removal of enemy obstacles.

c. Demolitions.—Engineers will be called upon to execute demolitions to hinder or canalize movements of hostile forces. All echelons of the engineer battalion are trained and equipped for this work.

CHAPTER 4

NONDIVISIONAL GENERAL UNITS

	Paragraphs
SECTION I. Corps combat regiment.....	67-73
II. General service regiment.....	74-76
III. Aviation regiment.....	77-82
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SECTION I

CORPS COMBAT REGIMENT

■ 67. GENERAL.—*a.* The corps combat regiment ordinarily performs general engineer work in the forward part of the corps area, and such engineer work in the division service areas as may be taken over by the corps. It is the primary source of engineer troops for reinforcing divisional engineer units.

b. Organization of the regiment is shown in figure 14. For details see tables XVI to XVIII, inclusive, appendix II.

c. Engineer tools and equipment are similar to those of the combat battalion and combat regiment, square division, and in addition the corps combat regiment has two power shovels, a road grader, and one unit of footbridge.

d. Transportation is sufficient to carry all personnel and material. Types of transportation are the same as for the combat battalion except for one 7½-ton cargo truck, prime mover for the ½-yard shovel.

e. Armament is similar to that of the combat battalion. The regiment is trained for combat as infantry. See paragraphs 20*b* and 29.

■ 68. PLATOON AND COMPANY.—The platoon and company of the corps combat regiment are identical to the platoon and company of the combat battalion with respect to organization, equipment, operations, and training (see pars. 36 and 37).

■ 69. BATTALION.—The battalion consists of a headquarters and three companies organized and equipped as shown in

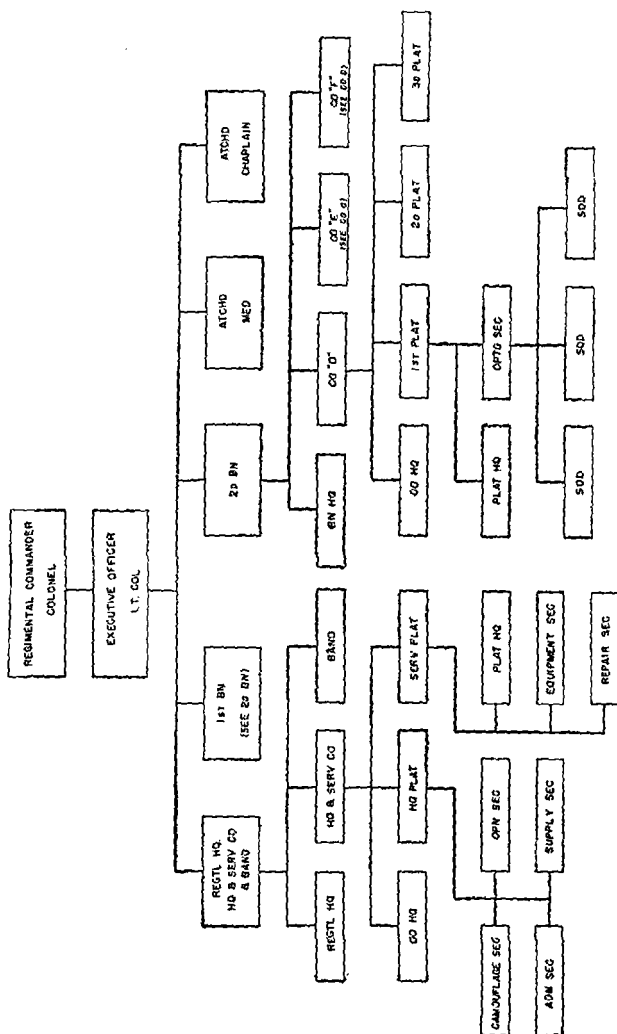


FIGURE 14.—Engineer regiment, combat (corps) (T/O 5-175).

table XVI, appendix II. Battalion headquarters contains only command personnel. It has no organic engineer equipment and no transportation, except that one $\frac{1}{2}$ -ton command truck in the regimental headquarters and service company is normally reserved for the use of each battalion headquarters. The battalion operates and is trained similarly to that of the divisional combat regiment (see par. 44 *b* and *c*).

■ 70. REGIMENTAL HEADQUARTERS AND HEADQUARTERS AND SERVICE COMPANY.—Regimental headquarters and the headquarters and service company of a corps combat regiment are organized and equipped as shown in table XVII, appendix II. They are trained and operate as described in paragraphs 10 *b*, *c*, and 45, except that the functions of intelligence (S-2) and operations (S-3) officers are combined under the operations officer, and that there is no assistant division engineer.

■ 71. BAND.—The band consists of one warrant officer and 28 enlisted men. Its mess, routine supply, and transportation are provided by headquarters and service company (see par. 10 *d*).

■ 72. ATTACHED MEDICAL.—The medical detachment is slightly larger than, but generally similar to, that of the combat regiment, square division, and operates as described in paragraph 13.

■ 73. EMPLOYMENT.—*a*. The major function of the regiment is to perform engineer work on roads, railroads, and bridges within the service area of its corps; on field fortifications for rearward defense of flanks of the corps; on corps command posts, supply installations, etc.; and on camouflage for all types of corps installations.

b. The corps combat regiment furnishes personnel and equipment for supporting or for reinforcing the divisional engineers, particularly for special operations such as river crossings. Support is accomplished ordinarily by taking over particular engineer work in a division rear area. Reinforcement is accomplished by attaching subordinate units of the regiment to the organic divisional engineer unit.

SECTION II

GENERAL SERVICE REGIMENT

■ 74. GENERAL.—The general service regiment performs general engineer work, particularly that requiring a high percentage of skilled labor, throughout the theater of operations.

■ 75. ORGANIZATION.—The general service regiment is in general similar to the corps combat regiment in organization, equipment, operations, and training. General organization of the regiment is shown in figure 15. For details see tables XIX to XXII, inclusive, appendix II. Major differences between it and the corps combat regiment are—

a. Transportation is sufficient for equipment and supplies but is not provided for personnel, and hence trucks for work purposes are materially reduced.

b. Squad does not have organic tools and transportation.

c. Both gasoline shovels in the headquarters and service company are $\frac{1}{2}$ -yard and both prime movers for the shovels are $7\frac{1}{2}$ -ton trucks. No assault boats, footbridge, or intrenching equipment are provided.

d. An engineer section is in place of the camouflage section in headquarters platoon of headquarters and service company.

■ 76. EMPLOYMENT.—a. The general service regiment is employed primarily on any of the following tasks:

(1) Building, repairing, and maintaining roads, railways, and bridges of all types.

(2) Constructing contonments, wharves, depots, and the like.

(3) Assisting in organization and preparation of rear defensive positions, including preparation of military demolitions, and construction of certain field fortifications.

(4) Operating public utilities.

(5) Installing and operating water supply facilities.

(6) Reinforcing or supporting corps engineers when necessary.

b. General service regiments are assigned as shown in table I, appendix II. This indicates that the mass of general service regiments will be employed normally on work in rear of the corps service areas.

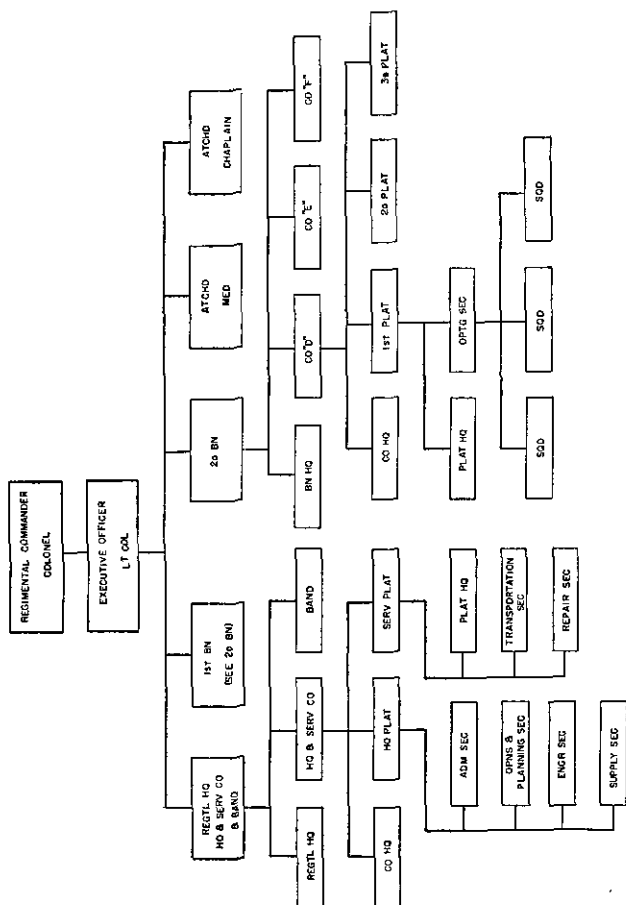


FIGURE 15.—Engineer regiment, general service (T/O 5-21).

c. The general service regiment is well adapted to work under the geographical assignment method. If parts of work in the area require special or reinforcing engineer units, these are attached to the general service regiment and operate under its control.

SECTION III

AVIATION REGIMENT

■ 77. **GENERAL.**—*a.* The engineer aviation regiment is a general engineer unit which is especially organized, trained, and equipped to meet needs of the GHQ Air Force for engineer work. Units of this type are assigned to the GHQ Air Force and operate under technical supervision of the engineer and camouflage section of the GHQ Air Force headquarters (see par. 9 *d* and fig. 8).

b. Organization of the regiment is shown in figure 16. For details of organization, see tables XXIII to XXV, inclusive, appendix II.

c. Power equipment includes motorized air compressors with air tools, road graders, carry-all scrapers, a trencher, tractor cranes, compaction rollers of various types, plows, gasoline shovels, a road material mixer, and tractors with bulldozers. Hand tools consist for the most part of standard carpenter, demolition, and pioneer sets (see par. 17).

d. The regiment is completely motorized including transportation for all personnel (see par. 18).

e. Armament consists of rifles and pistols but no machine guns (see par. 19).

f. The engineer training of the unit covers basic engineer subjects (see pars. 20 and 23) for general engineer units as modified to apply to its organization and functions. A large part of its personnel is selected from occupational specialists in highway, paving, earth-moving, and airport work; it also comprises mechanics, motor transport operators, and construction foremen of all types. The unit is organized in work teams corresponding to trained crews of specialized civil construction organizations. Long hours under conditions imposing peak loads and strain require that all personnel be maintained in the best possible physical condition. For basic, technical, and tactical training, see sections V and VI, chapter 1. Antiaircraft rifle training and defense against ground raids are emphasized for protection of air-dromes and bivouacs as well as convoys on the road. The organization should be trained in making rapid motor movements at night without prior notice.

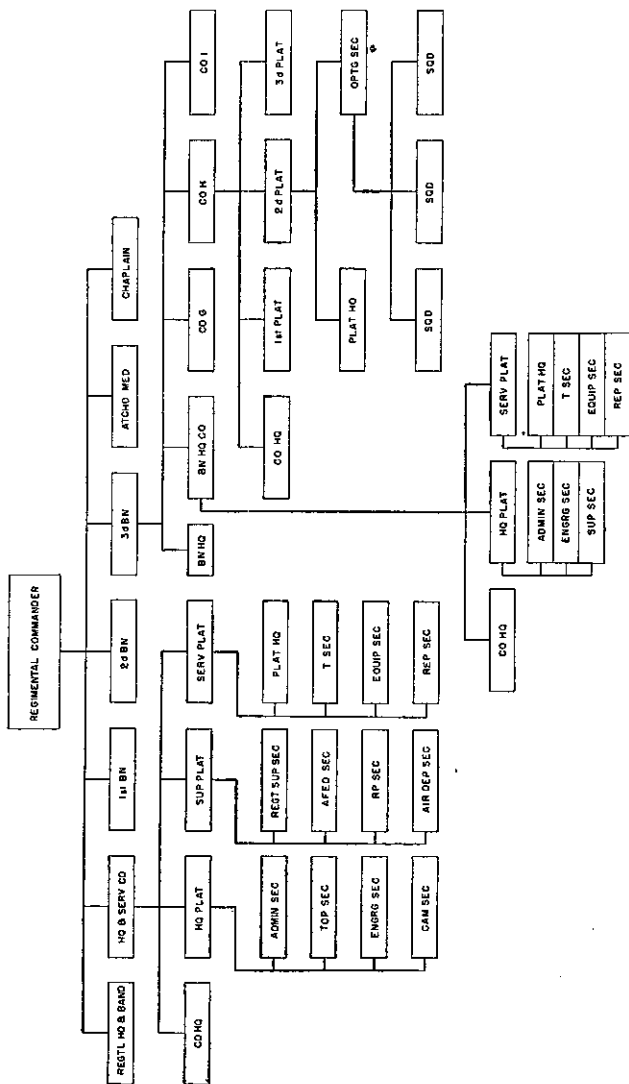


FIGURE 16.—Engineer regiment, aviation (T/O 5-411).

■ 78. PLATOON AND COMPANY.—The platoon and company of an engineer aviation regiment in general are similar to the platoon and company of a combat battalion with respect to organization, equipment, operations, and training (see par. 36 and 37) except—

a. The company has additional specialized equipment, including a heavy disk plow, a tractor plow, and a 500-gallon capacity portable storage tank.

b. In training of the aviation unit special stress is laid on technique of movement and stabilization of earth with the aid of construction machinery furnished by the battalion headquarters company and the headquarters and service company. Building construction and camouflage are also important.

c. The company is trained in route supply and maintenance for operating while at a considerable distance from other elements of the regiment.

d. No machine guns are assigned to platoons.

■ 79. BATTALION HEADQUARTERS AND HEADQUARTERS COMPANY.—The battalion headquarters and headquarters company is organized and equipped as shown in table XXIV, appendix II. The battalion is trained in general like the battalion of the divisional combat regiment (see par. 44 b and c). Its operations differ in that it has basically assigned to it a battalion headquarters company which makes it self-sufficient for administration and supply on detached missions. The battalion headquarters company includes a company headquarters, a headquarters platoon, and a service platoon.

■ 80. REGIMENTAL HEADQUARTERS AND HEADQUARTERS AND SERVICE COMPANY.—a. Regimental headquarters and headquarters and service company of an engineer aviation regiment are organized and equipped as shown in table XXIII, appendix II. They operate as described in paragraph 10 b and c, except that a topographic officer performs the duties of intelligence officer (S-2) and the engineering officer performs the duties of operations officer (S-3). The topographical section and the camouflage section of the headquarters platoon have personnel for handling normal amounts of such work.

b. The headquarters and service company of the aviation regiment is, in general, similar in organization and operation to the headquarters and service company of the corps combat regiment. The major differences of the aviation regiment unit are—

(1) It has a topographical section in the headquarters platoon.

(2) It has a transportation section in the service platoon.

(3) The supply problem is of such magnitude that it is handled by a supply platoon instead of by a supply section as in the corps combat regiment. The supply platoon has the following sections:

(a) Regimental supply section has duties similar to those of the supply section of headquarters platoon of the headquarters and service company of the corps combat regiment.

(b) Air force engineer depot section has the duty of supplying, storing, and distributing class IV engineer supplies, including construction and camouflage materials, but excluding small items of engineer issue to air units stocked by the engineer section of the air force depot.

(c) Refilling point section provides camouflage instruction and inspection service and operates the refilling point or points for camouflage materials and sandbags for all air units in the service area.

(d) Air depot section is the engineer section of the air force general depot. It provides articles of engineer issue to all air units in the air task force and stocks engineer items necessary in the theater except construction and camouflage materials.

c. The transportation section of the service platoon transports all equipment of the headquarters, and headquarters and service company.

d. For administrative and service functions, see paragraphs 10c and 12a. The headquarters and service company provides for the mess and routine supply of all headquarters personnel not detached. Training of headquarters personnel is best obtained by performing field duties with other elements of the regiment.

■ 81. ATTACHED MEDICAL.—The medical detachment consists of 11 officers and 54 enlisted men, organized into a

headquarters section and three battalion sections. Each section has a 1½-ton truck for the transportation of medical supplies and equipment; the headquarters section has in addition a ½-ton truck and a motorcycle with side car for command purposes. Functions of each of the medical sections are similar to those described in paragraph 13.

■ 82. EMPLOYMENT.—*a.* Principal functions of an aviation regiment are—

(1) Improvement or provision of advanced airdromes together with all appurtenances such as runways, landing strips, shelters, airplane parking areas, internal routes of communication, water supply, lighting, and other utilities.

(2) Improvement or provision of routes of communication to such airdromes.

(3) Provisions for gasproofing and bombproofing essential parts of such installations.

(4) Camouflage of advanced airdromes and other Air Corps installations.

(5) Map supply.

(6) Assistance in antimechanized defense of advanced airdromes by construction and defense of road blocks and combat against raids delivered by ground forces.

(7) Assistance in defense of advanced airdromes against air attack.

(8) Maintenance and repair of airdromes, especially after damage by enemy bombers.

b. Elements of the aviation regiment are employed on tasks which are usually scattered over a large area. Requirements of the air force for engineer work in various portions of the theater vary widely with movement of supported ground troops and aerial activity of the enemy. By proper use of its mobility and flexibility the aviation regiment can quickly concentrate well-trained units with great work capacity on emergency tasks which require rapid execution of large amounts of engineer work at vital points, and then disperse again in order to carry out less urgent tasks in numerous other scattered areas.

SECTION IV

SEPARATE BATTALION

■ 83. **GENERAL.**—*a.* The separate battalion is organically assigned to the armies and to GHQ as indicated in table I, appendix II. It performs general engineer work throughout the theater of operations. It is frequently attached to reinforce other general engineer units in whole or in part.

b. Organization and equipment of the battalion are shown in figure 17 and tables XXVI to XXIX, inclusive, appendix II.

c. Transportation is sufficient for equipment but not for personnel (see par. 18).

d. Armament consists of rifles, bayonets, and pistols (see par. 19).

e. For basic, technical, and tactical training see sections V and VI, chapter 1.

■ 84. **PLATOON.**—The platoon of the separate battalion consists of a platoon headquarters and nine operating units (squads) organized, armed, and equipped as shown in table XXVI, appendix II. As compared to the platoon of the combat battalion, it has three times as many operating units (squads), but the squads do not have organic transportation and tools. Functions of the various sections and training of the platoon as a whole are similar to that of the platoon of the combat battalion. However, because of the increased number of squads the platoon of the separate battalion may be organized for combat, close and extended order drills, and inspections in a manner similar to the company of the combat battalion (see par. 37). The platoon may operate on a definite task assigned by the company commander or it may be attached to some other engineer unit, in which case it is assigned tasks by the commander of the latter. Technical assistance may be provided by technical foremen and specialists assigned from company or battalion headquarters, or from the engineer unit to which the platoon may be attached.

■ 85. **COMPANY.**—The company of the separate battalion consists of a company headquarters and two platoons organized, armed, and equipped as shown in table XXVII, appendix II.

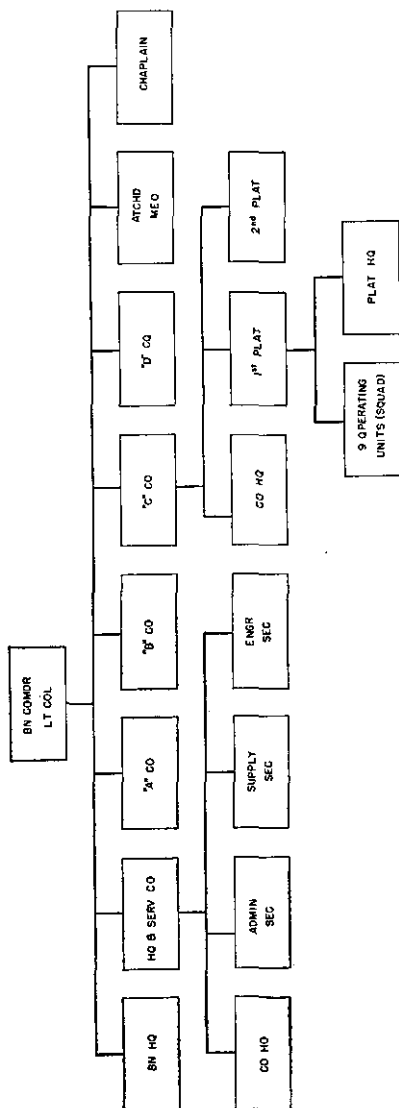


FIGURE 17.—Engineer battalion, separate (T/O 5-35).

It is similar to the company of the combat battalion with respect to operations and training (see par. 37). The work allotted or suballotted the company normally involves a low order of technical skill. Company transportation is not sufficient to keep up a constant supply of material for extensive road and railroad work. Being administratively self-sustaining, the company can be employed on detached missions without special arrangements being made for routine supply. The company may be employed on a task under its battalion commander or it may be attached to some other engineer unit. It may be employed as a unit or its platoons may be attached to subordinate units of the unit to which it is attached.

■ 86. BATTALION HEADQUARTERS, AND HEADQUARTERS AND SERVICE COMPANY.—Battalion headquarters, and headquarters and service company of the separate battalion are organized, armed, and equipped as shown in table XXVIII, appendix II. The battalion staff functions as described in paragraph 10b, except that no assistant division engineer is provided, that functions of intelligence (S-2) and operations (S-3) officers are combined under the operations officer, and that the commanding officer of headquarters and service company is also the battalion supply officer (S-4). The headquarters and service company performs administrative and supply functions as prescribed in paragraphs 10c and 16b. For training, see section V, chapter 1.

■ 87. EMPLOYMENT.—The separate battalion may be employed independently or may be attached to another engineer unit to augment its work capacity. In the latter case, normal assignment is at the rate of one separate battalion per engineer regiment. When working with a regiment the battalion may work as a unit or may be used to reinforce the battalions of the regiment. If the battalion is subdivided for attachment, effort should be made to keep lower units intact as far as practicable, remaining units being left for work under the battalion commander. For purposes of estimating work, the battalion may be considered as furnishing about 900 men, exclusive of foremen and overseers.

CHAPTER 5

CAMOUFLAGE UNITS

SECTION		Paragraphs
I.	General.....	88-91
II.	Army camouflage battalion.....	92-97
III.	GHQ camouflage battalion.....	98-104

SECTION I

GENERAL

■ 88. MISSION.—The primary mission of camouflage units is camouflage inspection, discipline, training, planning, experimentation, manufacture, and supply. Erection of camouflage is *not* normally the duty of camouflage troops. For camouflage technique see FM 5-20.

■ 89. PERSONNEL.—Personnel of camouflage units consists largely of skilled technicians and specialists. In view of the nature of the work on which units are employed it is essential that personnel be recruited from men trained in civil life along lines of work expected of them in the military service. Such specialists include men associated with motion picture and theatrical art departments such as art directors, property men, model builders, scenery builders, special effects men, etc.; landscape architects; painters; mechanics; riggers; carpenters, etc.

■ 90. TRAINING.—For basic and combat training of camouflage units see section V, chapter 1. Engineer training comprises characteristics and practice of camouflage technique; construction and erection of devices used in camouflage operations; planning of general and special camouflage installations; manufacture of camouflage materials; instruction in camouflage discipline for troops of all arms and methods of securing its enforcement; interpretation of aerial photographs with reference to visibility of camouflage from the air and detection of camouflaged enemy activities; selection of positions for installations of all kinds with a view to protection

from enemy observation and detection; and system of supply of camouflage materials to all arms. In view of the general nature of camouflage activities attention must be paid to necessity for close cooperation with units of other arms.

■ 91. COMBAT.—See section VI, chapter 1.

SECTION II

ARMY CAMOUFLAGE BATTALION

■ 92. GENERAL.—*a. Mission.*—The primary mission of the army camouflage battalion is camouflage inspection, disci-

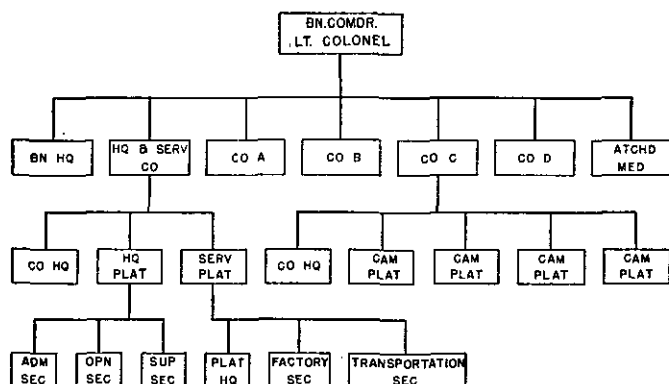


FIGURE 18.—Army camouflage battalion (T/O 5-95).

pline, and training in the army area. It also conducts experiments for new camouflage methods and prepares detailed plans for general or special camouflage installations.

b. Organization.—The army camouflage battalion consists of a headquarters, a headquarters and service company, and four companies organized generally as shown in figure 18. For normal organic assignment to major units see table I, appendix II.

c. Transportation and equipment.—The army camouflage battalion is equipped to transport camouflage inspection and demonstration parties, to operate schools for camouflage instruction, to erect camouflage, and to fabricate camouflage

materials in limited quantities. For this latter function equipment of the factory section of the service platoon of the headquarters and service company is suitable principally for adaptation of materials previously fabricated by camouflage factories of the GHQ camouflage battalion in the communications zone.

■ 93. **BATTALION HEADQUARTERS.**—Battalion headquarters (see table XXX, app. II) includes the battalion commander and his staff. The staff officers are an adjutant, an operations officer, a supply officer, and a surgeon. Their duties are in general as described in paragraph 11.

■ 94. **HEADQUARTERS AND SERVICE COMPANY.**—*a. General.*—Headquarters and service company (see table XXXI, app. II), in addition to routine administration, mess, and supply, adapts to local conditions camouflage materials obtained from the army depot establishments and arranges for delivery of the materials to the camouflage companies. The headquarters and service company may also be charged with conducting a course of instruction in camouflage fundamentals and technique in army or corps schools. Detailed organization and qualifications of the principal noncommissioned officers and specialists are given in T/O 5-96.

b. Company headquarters.—Operates as described in paragraph 12.

c. Headquarters platoon.—(1) *Administrative section.*—Includes usual headquarters clerical personnel.

(2) *Operations section.*—Under the operations officer plans and sets up pilot models of camouflage installations, and gives instruction to and furnishes drawings for use of personnel of the camouflage companies.

(3) *Supply section.*—Under the supply officer handles camouflage supply in addition to regular administrative battalion supply.

d. Service platoon.—(1) *Platoon headquarters* includes the officer who commands the platoon and a small technical and command group.

(2) *Factory section.*—Under an officer conducts factory operations, including planning, design, supervision, fabrication, painting, and supply.

(3) *Transportation section.*—Under a corporal truckmaster maintains and operates all transportation of the service platoon.

■ 95. COMPANY.—*a. General.*—The camouflage company (see table XXXII, app. II) consists of a company headquarters and four camouflage platoons. Detailed organization and qualifications of the principal noncommissioned officers and specialists are given in T/O 5-97.

b. Company headquarters.—Under the company commander is responsible for routine administration of the company and for its operation.

c. Platoon.—(1) *Organization.*—The camouflage platoon is commanded by a commissioned officer and includes technical supervisors and command personnel, overseers for detached sections of the platoon, camoufleurs, general carpenters, painters, and chauffeurs for platoon transportation.

(2) *Equipment.*—(a) Equipment of this unit consists of a camouflage set which includes hand tools and a paint-spraying machine. The platoon carries a small quantity of camouflage materials such as wire, rope, osnaburg, cotton cloth, nets, stakes, paints, etc.

(b) Additional transportation such as pick-up trucks or motorcycles with side car, when needed for officers engaged in field inspection work, is obtained from army or higher echelon motor pools.

(3) *Operations.*—(a) The platoon is the basic operating unit. Camouflage work is normally executed by troops of the arm whose installations are being protected. Major camouflage projects for installations common to all arms are normally executed by general engineer troops, but the plan for such major projects is prepared by the camouflage unit or approved by the unit camouflage officer. Exceptionally, minor camouflage projects common to all arms may be executed by camouflage troops. Normal duties of the camouflage platoon are to render assistance by demonstration and instruction to troops occupying an area, and to plan general or special camouflage installations.

(b) The area which one platoon can cover varies from 10 to 50 square miles, depending upon the road net and the

military concentration and installations. Members of the platoon travel through their assigned areas, observe the state of camouflage discipline, note where improvements or action are necessary, lend assistance, and give expert advice as required. They are careful to report their observations only through the immediate troop or installation commander concerned, suggesting corrective measures where errors of camouflage technique are discovered. They may often aid and facilitate distribution of camouflage supplies. They make periodical and emergency reports to the platoon commander who takes appropriate action, preferably by direct conference with commanders concerned, or through channels if other action is not effective. The platoon may be subdivided into sections and the latter given area missions.

■ 96. ATTACHED MEDICAL.—The medical detachment is organized in general as described in paragraph 13.

■ 97. OPERATIONS.—*a.* Operations of the army camouflage battalion are those generally described by its mission (see par. 92).

b. It usually is made responsible for camouflage operations within a prescribed area. Small detachments may be dispersed through this area or the unit may operate from a central point. The division of the battalion area into sub-areas is published in army orders based upon approved recommendations made to the army engineer by the commanding officer of the camouflage battalion. The subdivision into geographical areas is based upon the difficulty of carrying out local camouflage operations. Under exceptional circumstances a camouflage unit may be attached to a tactical unit such as a detached corps.

c. (1) It is essential that the battalion commence operations as soon as practicable when assigned to a new area. Combat troops must be informed promptly on local camouflage matters before they reveal their presence to the enemy by exposing their equipment and personnel to air or ground observation. When a situation has stabilized and construction of field fortifications commences, personnel of the battalion must be available to assist in camouflage of the position. Personnel assigned to areas should if possible be retained.

regardless of any changes in other tactical dispositions. This insures a continuity of camouflage policy in the area. Their study of characteristics of the terrain and the effect of seasonal changes upon camouflage will insure success of the battalion mission.

(2) In a rapidly moving situation work of the battalion will be concentrated on those installations which will remain in the same locality at least from several days to a few weeks, and upon parks or sites for large or important supply installations. This will necessitate prompt and complete knowledge of the army G-4 plan. The battalion commander should be prepared to accompany representatives of G-4 in reconnaissance of such locations.

SECTION III

GHQ CAMOUFLAGE BATTALION

■ 98. **GENERAL.**—*a. Mission.*—The GHQ camouflage battalion is primarily a manufacturing unit. Its mission also includes camouflage inspection and training, experimentation for new camouflage methods, preparation of camouflage plans for large or special installations, and supply of camouflage materials. Its equipment is similar to that of the army camouflage battalion, except that it has heavier and less mobile factory equipment. It forms the nucleus for organization of large camouflage factories and depots.

b. Organization.—The GHQ camouflage battalion consists of a headquarters, a headquarters and service company, a camouflage company, and a shop company organized generally as shown in figure 19 and table XXXIII, appendix II. For typical assignment to a GHQ force see table I, appendix II.

c. Equipment.—The GHQ camouflage battalion is equipped to fabricate and erect camouflage materials, to transport inspection and demonstration parties, and to operate schools for camouflage instruction.

d. For drill of the unit, for disciplinary training, and for movement with or without transportation, appropriate adaptations of the drills prescribed in FM 22-5 will be used.

■ 99. **BATTALION HEADQUARTERS.**—Battalion headquarters (see table XXXIII, app. II) includes the battalion commander and

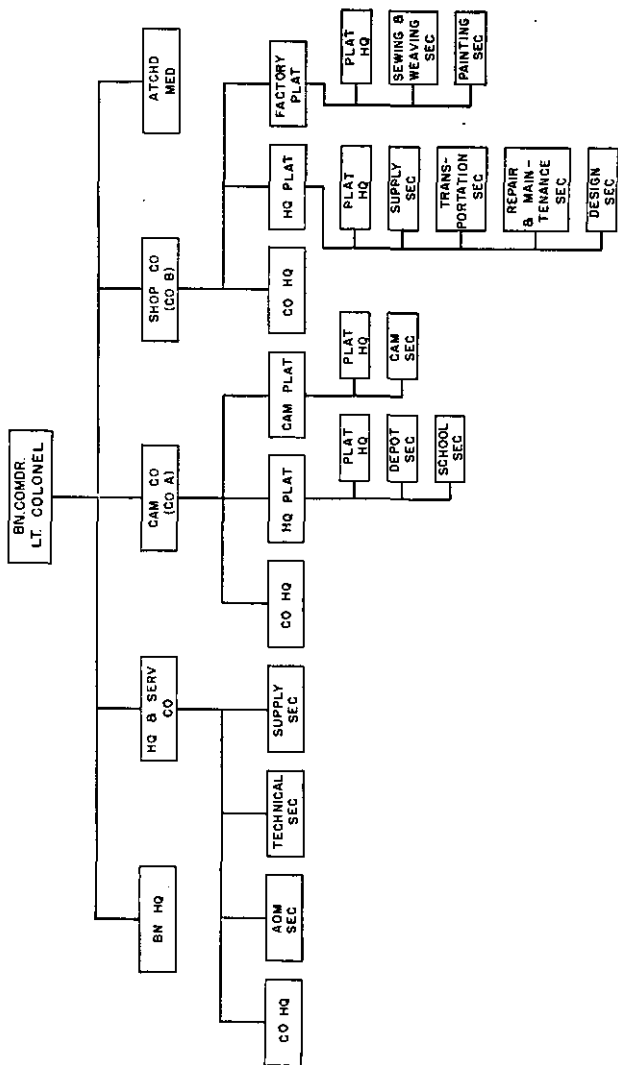


FIGURE 19.—GHQ camouflage battalion (T/O 5-135).

his staff. The staff officers are an adjutant, a technical officer, a supply officer, and a surgeon. Their duties are in general as described in paragraph 11, except that the technical officer combines S-2 and S-3 duties.

■ 100. HEADQUARTERS AND SERVICE COMPANY.—*a. General.*—Headquarters and service company (see table XXXIV, app. II) includes personnel for operating the various staff sections of battalion headquarters and for supply service for the battalion. Its equipment includes organizational equipment and supplies for the office of the battalion headquarters, routine administration and supply, shelter, and the battalion mess. Detailed organization and qualifications of the principal non-commissioned officers and specialists are given in T/O 5-136.

b. Company headquarters.—Includes personnel for administration of the company, messing of the company and battalion headquarters, and operation of its assigned motor vehicles. The company commander is also the battalion supply officer. His commissioned assistant is the assistant supply officer and regularly handles details of company administration and the battalion mess.

c. Administrative section.—Includes usual clerical personnel for routine administration, clerical work, mimeographing, postal service, and operating the message center.

d. Technical section.—Under the technical officer includes camoufleurs, clerks, draftsmen, and photographers. This section makes studies of camouflage needs in the communications zone, recommends measures to meet these needs, and by study of aerial photographs, reports, inspections, and other means, determines effectiveness of measures adopted. It also prepares technical instructional matter to be distributed to troops of other arms in connection with camouflage operations and prepares plans for camouflage of large installations.

e. Supply section.—Under the supply officer handles supply of camouflage materials to be processed as well as routine battalion supply.

■ 101. CAMOUFLAGE COMPANY.—*a. General.*—This company (see table XXXV, app. II) operates in the areas behind the armies as described in paragraph 95 for the army camouflage company. Its camouflage equipment is similar to that of the

army camouflage company (see par. 95). Its transportation carries necessary equipment and provides transportation for normal reconnaissance, inspection, and camouflage parties, together with usual supplies and equipment. Additional transportation for personnel engaged on field inspection work must be obtained from communications zone motor pools. Detailed organization and qualifications of the principal noncommissioned officers and specialists are given in T/O 5-137.

b. Company headquarters.—In addition to the company commander and his commissioned assistant, includes enlisted men for routine administration of the company. It is charged with operation and maintenance of transportation assigned to company headquarters.

c. Headquarters platoon.—(1) *Platoon headquarters.*—Includes the platoon commander, a commissioned assistant who is available for any duty, and a small command and supervisory group.

(2) *Depot section.*—Consists of storekeepers, camoufleurs, carpenters, mechanics, and clerks. It handles distribution of camouflage material to supply points in the theater of operations and operates separate camouflage depots or dumps in the communications zone. Personnel from this section may be attached to engineer depots to assist in camouflage supply.

(3) *School section.*—Consists of camoufleurs, carpenters, and painters. This section is employed for demonstration and instructional purposes at training camps or schools in the communications zone, and experimentation with new methods. Schools should be under general charge of an officer.

d. Camouflage platoon.—Operates in a manner similar to that described in paragraph 95 for the platoon of the army camouflage company.

(1) *Platoon headquarters.*—Includes one officer who commands the platoon, a commissioned assistant and a camoufleur who assist the platoon commander in planning, messengers, and chauffeurs.

(2) *Camouflage section.*—Includes officers for field supervision of camouflage projects, foremen who take charge of field groups engaged on camouflage operations, and camoufleurs, carpenters, painters, and chauffeurs for execution of assigned work.

■ 102. SHOP COMPANY.—*a. General.*—The shop company (see table XXXVI, app. II) furnishes personnel for manufacture and adaptation of camouflage materials. Its transportation provides for carrying messing facilities, and for transportation of reconnaissance and inspection parties, supplies, and equipment. Detailed organization and qualifications of the principal noncommissioned officers and specialists are given in T/O 5-138.

b. Company headquarters.—In addition to their command duties, the company commander and his commissioned assistant are factory superintendent and assistant factory superintendent, respectively. Enlisted personnel comprise the complement for necessary routine administration.

c. Headquarters platoon.—Procures and distributes raw materials for camouflage manufacture, designs camouflage materials, and conducts experimental work.

(1) *Platoon headquarters.*—Consists of the platoon commander, a commissioned assistant who is available for any duty, and a small enlisted group for command purposes and technical planning.

(2) *Supply section.*—Consists of mechanic foremen, storekeepers, and clerks. It handles storage and issue of materials for the factory and routine company supply.

(3) *Transportation section.*—Consists of a motor corporal and chauffeurs who operate motor vehicles assigned to the section.

(4) *Repair and maintenance section.*—Consists of a millwright in charge of repair work, mechanic foremen, blacksmiths, electricians, pipe fitters, machinists, mechanics, and welders. This section is charged with general maintenance of factory equipment and transportation.

(5) *Design section.*—Consists of camoufleurs, a model maker, carpenters, clerks, and draftsmen. This section sets up pilot models of camouflage installations, develops new camouflage devices, and gives instructions to and furnishes drawings for use of personnel of the shop company. It is also charged with compiling statistical information concerning factory production.

d. Factory platoon.—Operates a central camouflage factory for preparation of materials to be delivered to using troops in

either the communications or the combat zone. It sews and weaves raw materials, makes nets, repairs salvaged materials, and applies colors by brushing, spraying, or dipping. Its equipment consists of paint grinding and mixing machines, paint-spraying machines, and sewing machines for manufacture of camouflage material.

(1) *Platoon headquarters*.—Consists of the platoon commander, a commissioned assistant who is available for any duty, a platoon sergeant, a camoufleur, and a clerk.

(2) *Sewing and weaving section*.—Consists of mechanic foremen, canvas workers, and camoufleurs who manufacture camouflage fabrics. When the battalion forms the nucleus for a large camouflage factory this section will employ native civilian labor and hence personnel must be capable of directing small groups of such labor.

(3) *Painting section*.—Consists of a paint mill foreman, mechanic foremen, painters, and camoufleurs. This section is charged with preparation and application of camouflage paint.

■ 103. ATTACHED MEDICAL.—The medical detachment is organized in general as described in paragraph 13.

■ 104. OPERATIONS.—*a.* In addition to manufacturing and supplying camouflage materials for the field forces, the battalion may execute camouflage construction of a minor nature where the works are for the benefit of all arms. In general, however, camouflage construction is executed by troops of the arms whose activity is being camouflaged, the camouflage battalion furnishing instruction, inspection, and specialists to assist in some cases. Major camouflage projects in the theater of operations common to all arms are normally constructed by general engineer troops based on plans prepared by the camouflage battalion or approved by the unit camouflage officer.

b. The commander of the battalion has his headquarters near that of the chief engineer of the field forces. He may recommend to the chief engineer disposition and responsibilities of the battalion which, if approved, are published in general orders for guidance of the command.

CHAPTER 6

PONTON UNITS

	Paragraphs
SECTION I. Light ponton company.....	105-108
II. Heavy ponton battalion.....	109-113

SECTION I

LIGHT PONTON COMPANY

■ 105. GENERAL.—*a. Mission.*—The light ponton company maintains and transports river-crossing equipment as listed in *d* below. Construction of ponton bridges is a function of general engineer troops. However, ponton company per-

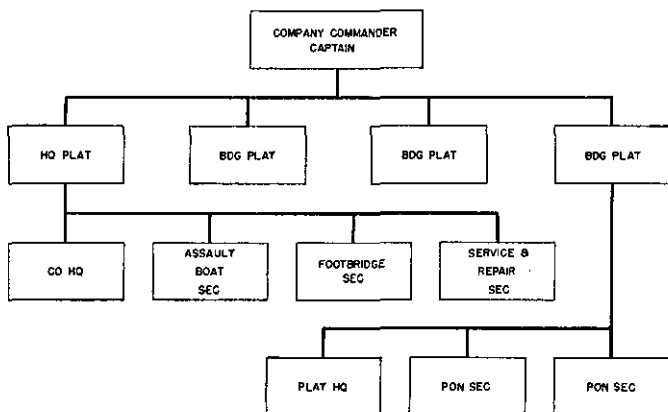


FIGURE 20.—Light ponton company (T/O 5-87).

sonnel may supplement general engineer troops on this work in an emergency. The company may be employed to instruct other troops in use of the equipment, to guard and maintain completed bridges, to regulate traffic thereon, and to dismantle bridges.

b. Organization.—The light ponton company consists of a headquarters platoon and three bridge platoons organized as shown in figure 20 and table XXXVII, appendix II.

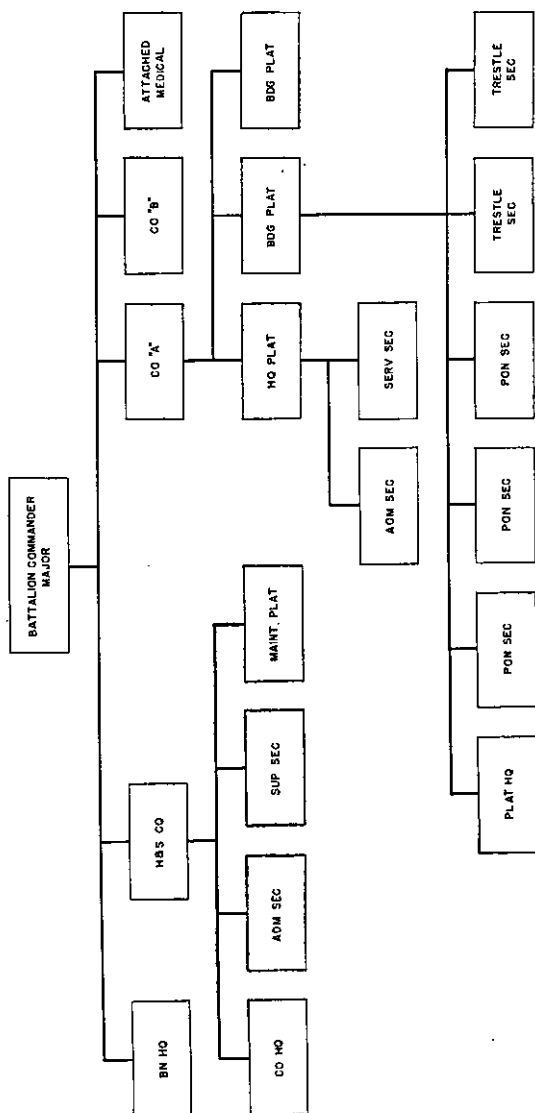


FIGURE 21.—Heavy ponton battalion (T/O 5-275).

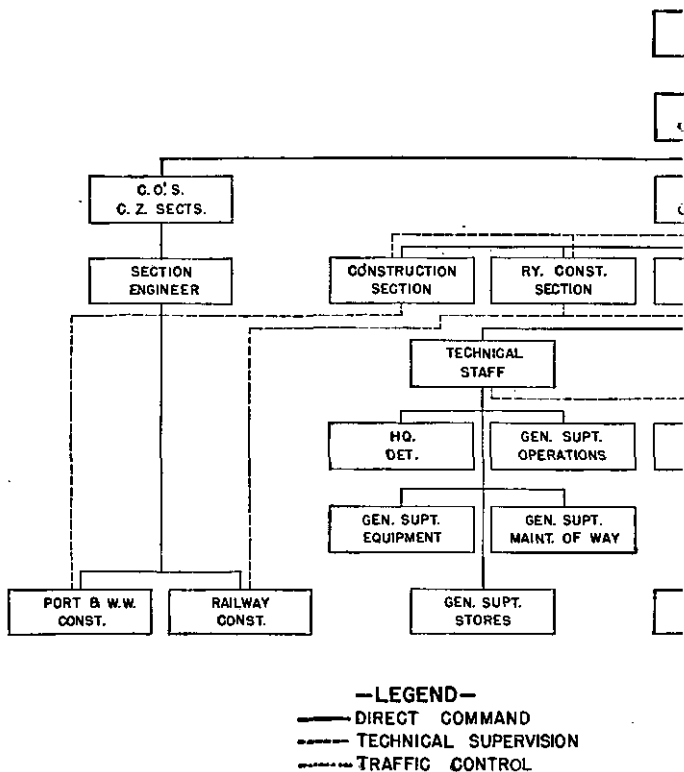
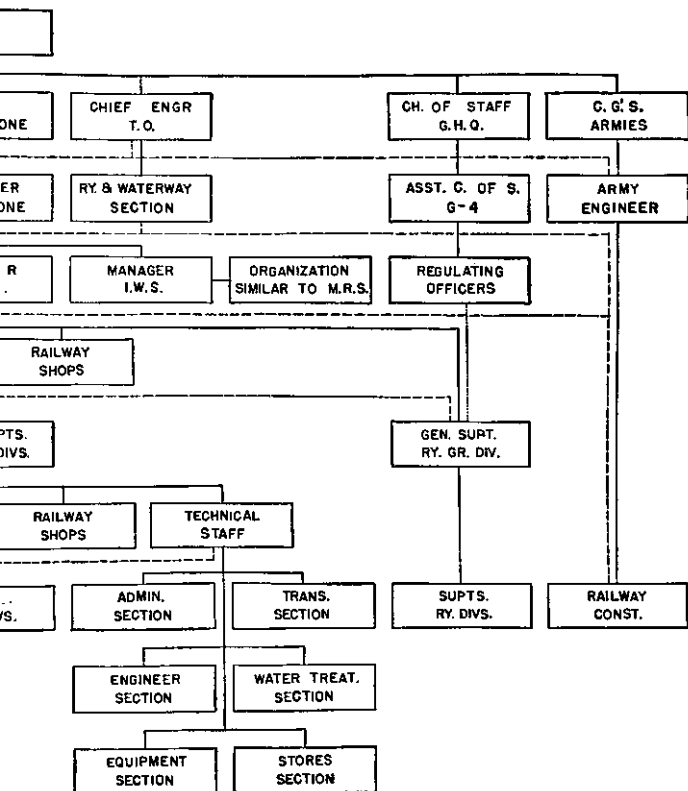


FIGURE 22.—Organization of military railway



and inland waterways, theater of operations.

c. *Assignment*.—Assignment of light ponton companies in a GHQ force is given in table I, appendix II. Attachment of light ponton companies to corps and divisions engaged in river-crossing operations will be made in accordance with needs of these units for the particular operation (see sec. II, ch. 13).

d. *Equipment*.—(1) River-crossing equipment of the company is of three types as follows:

(a) 3 units of light ponton equipage, 10-ton, M1938, each unit providing sufficient equipment for a complete bridge approximately 250 feet in length.

(b) 3 units of footbridge, M1935, each unit providing equipment for 432 feet of bridge.

(c) 120 assault boats, each with a capacity of 7 to 9 men and a 2-man crew.

(2) The company includes in its organically assigned transportation all necessary vehicles except the prime movers for the 99 trailers on which the ponton bridge equipage is transported. These prime movers must be furnished in whole or in part by higher command, depending upon necessity for a simultaneous or successive movement of the equipage. When circumstances permit, the 24 trucks used for transportation of assault boats and footbridge equipment can be used for drawing trailers.

e. *Training*.—(1) *Engineer*.—The unit is trained in performance of all duties listed in *a* above, including emergency construction of foot or ponton bridges and supply of assault boat crews.

(2) *Basic, technical, and tactical*.—See sections V and VI, chapter 1.

f. *Combat*.—See paragraph 30. Antiaircraft defense is essential.

■ 106. HEADQUARTERS PLATOON (see fig. 20 and table XXXVII, app. II).—*a. Company headquarters*.—Organization and duties of this section are similar to those for a company headquarters as listed in paragraph 12*a*.

b. Assault boat section.—Cares for the 120 assault boats assigned to the light ponton company.

c. Footbridge section.—Cares for the three footbridge units assigned to the ponton company.

d. Service and repair section.—Consists of 1 lieutenant, and 19 enlisted men of various qualifications necessary to maintain company transportation and equipment.

■ 107. BRIDGE PLATOON (see fig. 20 and table XXXVII, app. II).—The platoon has one unit (250 feet) of ponton equipment, complete with all accessories. The unit proper is transported on 33 two-wheeled trailers. Accessories are transported in three 1½-ton trucks and a 1-ton cargo trailer.

a. Platoon headquarters.—Consists of one lieutenant, platoon commander; command group, chauffeurs, and tractor operators. It cares for the trailer load of spare trestle balk assigned to the platoon and for the accessories.

b. Ponton section.—Consists of 1 sergeant, section leader, 1 corporal, assistant section leader, and 13 privates. The sergeant commands the section and is responsible for 6 ponton loads, 6 deck loads, 3 abutment loads, 1 trestle load, and the 16 trailers which transport them.

■ 108. OPERATIONS.—*a. In company ponton park.*—The primary function of the ponton company while being held in a rear area is to keep its transportation and equipment ready for employment. In addition to storage maintenance, the equipment should be tested periodically to eliminate parts which may have deteriorated so that they are no longer safe. However, this work may not employ full time of all men, transportation, and equipment. When primary duties permit, a part of the men of the company may be employed for training their own or other personnel, to reinforce engineer depot personnel, to maintain or repair roads near the ponton park, or to assist other nearby engineer units in performance of their duties.

b. Employment while moving forward to river crossing.—(1) The extra trucks for transporting the light ponton company may be assigned from division, corps, or army quartermaster trucks. In march column when closed up at a halt, the ponton company with its attached truck units occupies about 1 mile of road space. At night without lights the column can average about 10 miles per hour and in the daytime about 25 miles per hour. At these speeds it occupies about 2.1 and 6.9 miles of road space, respectively.

(2) Subordinate elements of the ponton company may be attached to different divisions for a river crossing. On reaching the area of the division to which attached, each such element usually will be attached to general engineer units which are charged with construction of ponton or footbridges or employment of assault boats. Personnel from the ponton company accompanies equipment to which it pertains. The footbridge and assault boat sections ordinarily join the engineer units to which they are attached at the bivouac area of these units. The bridge platoons, on the other hand, join the engineer units to which they are attached at initial control points as designated by orders of higher command for the crossing. This difference is due to the fact that the footbridge and assault boat sections are fairly easy to conceal, occupying only a small amount of road space, and must be greatly spread out along the river line by the general engineer troops, while the ponton equipment is much more difficult to conceal, occupies much road space, and thus is vulnerable to hostile artillery and air concentrations. The ponton equipment should be held well back and moved rapidly to initial control points with only leeway enough to avoid unnecessary delay at these points. For details covering selection of crossing points and bridge sites and for erection procedure, see section II, chapter 13, and TM 5-270.

c. Employment at bridge site.—(1) Bridges and ferries are constructed by general engineer units. As long as heavy traffic, effective bombardment, or adverse weather conditions prevail, the general engineer unit will continue to maintain and operate the equipment. However, when such units are needed for other work in forward areas, operation and maintenance of floating bridges and ferries may be turned over to the light ponton company. The ponton company may also be required to dismantle the bridge and transport it to a new park.

(2) Maintenance of a ponton bridge includes replacement or repair of damaged sections resulting from hostile fire, adverse river conditions, or traffic.

(a) Normally, construction is not undertaken until hostile direct small-arms fire on the site is definitely overcome and

hostile terrestrial observation greatly limited. However, high angle artillery fire adjusted by aerial observation may be effective during construction and later until the bridgehead objective is secured. The bridge will always be a particular target for hostile bombardment aviation. For these reasons additional equipage is usually provided for reserve, the amount depending on both tactical and technical estimate of the situation. While the special antiaircraft defense forces furnished will materially reduce damage, heavy surprise aerial attacks must be expected until more important objectives develop for the enemy. Actual replacements of damaged sections will be undertaken by general engineers when present, repair or salvage devolving upon the ponton company.

(b) The bridge must be kept clear of drift and other floating objects, especial attention being given to anchor cables. If the floating objects are not too large or too numerous, they may be passed under the bridge by men working with pike poles from the boats and roadway. Floating objects may be prevented from striking the bridge by guards upstream, or by a drawspan in the bridge, or by a floating boom upstream crossing the stream obliquely.

(c) A continuous guard is always posted at a floating bridge. Sentries are posted at each end, and if the bridge is long, at intermediate points. The remainder of the guard should be quartered near one end of the bridge. Sentries notify the guard commander whenever the bridge is endangered. They alternate one-way traffic over the bridge. A telephone or signal system between the ends of the bridge facilitates this operation. With approval of higher authority, orders should be published showing characteristics of loads permitted on the bridge, and furnished to column commanders at some distance from the bridge and to sentries for enforcement.

d. Technical details of nature and use of equipment of the company are covered in TM 5-270 and FM 5-10.

SECTION II

HEAVY PONTON BATTALION

■ 109. GENERAL.—*a. Mission.*—The heavy ponton battalion maintains and transports the heavy ponton equipage, 25-ton,

M1940. The battalion is not organized primarily for construction, its functions in this respect being similar to the light ponton company (see par. 105). However, under certain circumstances (see par. 113a), the battalion may construct the bridge.

b. Assignment.—Assignment of heavy ponton battalions to a balanced GHQ force is given in table I, appendix II.

c. Organization.—The battalion is organized into a battalion headquarters, a headquarters and service company, two lettered companies, and a medical detachment as shown in figure 21 and table XXXVIII, appendix II.

d. Equipment.—(1) In contrast to the light ponton company, the heavy ponton battalion includes in its organic equipment all transportation, including trucks, necessary for movement of equipment and personnel.

(2) Bridging equipment of the battalion comprises four complete units of heavy ponton equipage. One unit of the equipage, affording about 250 feet of bridge, is carried by each of the four bridge platoons of the two lettered companies. The battalion equipment includes also tools and spare parts necessary for ponton maintenance, and organizational equipment for self-maintenance, interior administration, and supply. Equipment pertaining to the battalion as a whole is carried and maintained by the headquarters and service company.

(3) The four units of bridge equipage are carried on semi-trailers.

(4) All other equipment is carried in the trucks assigned to the battalion.

e. Training.—(1) *Engineer.*—The battalion is trained in its principal duties of maintaining and transporting the heavy ponton equipage, and in other duties referred to in *a* above.

(2) *Basic, technical, and tactical.*—See sections V and VI, chapter 1.

f. Combat.—See paragraph 30.

■ 110. BATTALION HEADQUARTERS (see table XXXIX, app. II).—Consists of the battalion commander and his adjutant who is in direct charge of the administrative section of headquarters and service company and handles the routine administrative clerical work for the battalion. The commander of

headquarters and service company is also the battalion supply officer.

■ 111. HEADQUARTERS AND SERVICE COMPANY (see table XXXIX, app. II).—*a. Mission.*—In addition to duties and equipment prescribed in paragraphs 10c and 16b, the headquarters and service company is charged with repair and upkeep of the ponton equipage carried by lettered companies. Principal engineer equipment includes blacksmith, carpenter, pipe-fitting, tinsmith, and sign-painting.

b. Transportation.—See paragraph 18.

c. Training.—In addition to basic, technical, and tactical training prescribed in sections V and VI, chapter 1, the headquarters and service company is trained in storage and maintenance of ponton equipment and motor vehicles.

d. Company headquarters.—See paragraph 12a.

e. Administrative section.—See paragraph 10b.

f. Supply section.—See paragraph 10b.

g. Maintenance platoon.—Has necessary personnel, including mechanics, blacksmiths, carpenters, painters, riggers, and wheelwright, principally for repair of trucks and trailers and maintenance of ponton equipage beyond capabilities of the lettered companies. It also includes necessary chauffeurs and laborers for operation of trucks and tractors assigned to the section for assistance of the lettered companies. Principal duties in this regard will be moving ponton equipment in the park or at the bridge site and assistance in heavy abutment construction, etc.

■ 112. LETTERED COMPANY (see table XL, app. II).—*a. Mission.*—The primary function of the lettered company is transportation and maintenance of two units of ponton equipage. For organizational equipment see paragraph 16. Principal engineer equipment is the ponton equipage, one unit of which is assigned to each of the two bridge platoons.

b. Transportation.—The company as shown in table XL, appendix II, includes in its organic equipment all transportation, including trucks necessary for movement of equipment and personnel.

c. Training.—(1) *Engineer.*—The company is trained in care, operation, and use of its ponton equipage, equipment, and transportation.

(2) *Basic, technical, and tactical.*—See sections V and VI, chapter 1.

d. Headquarters platoon.—(1) *Administrative section.*—Consists of the company commander, his commissioned assistant, and necessary enlisted personnel for routine company administration.

(2) *Service section.*—Consists of necessary enlisted personnel, including mechanics, blacksmiths, carpenters, chauffeurs, painters, riggers, wheelwright, and laborer for maintenance and repair of company equipment and transportation.

e. Bridge platoon.—Has one unit of ponton equipage assigned within the platoon to the various sections as shown in table XL, appendix II.

(1) *Platoon headquarters section.*—Contains the first lieutenant, commanding; a staff sergeant (platoon sergeant); a maintenance and operating group; and chauffeurs.

(2) *Ponton sections.*—Each of the three ponton sections includes a sergeant (section leader); a corporal (assistant section leader); a winch operator; riggers; and a chauffeur for each of the four ponton loads assigned. The sergeant (section leader) commands section and is responsible for proper maintenance and transportation of equipment.

(3) *Trestle sections.*—Each of the two trestle sections contains a sergeant (section leader); a corporal (assistant section leader); a winch operator; a rigger; and two chauffeurs.

■ 113. OPERATIONS.—*a.* Employment of the heavy ponton battalion, while similar in general to that of the light ponton company, differs in the following respects:

(1) *Self-sufficiency of motor transportation.*—The heavy ponton battalion has all necessary transportation for movement of personnel, baggage, and equipment. This eliminates—

(a) Difficulty of promptly securing trucks for convoy movements.

(b) Disagreement as to responsibility of ponton unit commander and truck unit commander.

(c) Slow speed of convoys due to the fact that truck drivers who have not had wide experience in hauling trailers

are generally overcautious when assigned the duty of transporting ponton equipage.

(d) Difficulties in forming convoy with inexperienced truck units.

(2) *Concealment.*—The semitrailers of the heavy ponton battalion are of such size that they seldom can be concealed successfully in woods unless the foliage is very heavy; in general, reliance must be placed on more complex camouflage measures.

(3) *Simplicity of duties.*—The heavy ponton battalion provides only one type of stream-crossing equipment, that is, the 25-ton equipment to provide ponton bridges and possibly rafts to carry medium tanks, whereas the light ponton company provides for crossing by means of assault boats, foot-bridges, individual ponton ferries, and raft ferries as well as the ponton bridge.

(4) *Simplicity of tactical employment.*—The 25-ton ponton bridge will normally not be built until advance of friendly troops eliminates hostile artillery fire on definite bridge sites. The equipage will then move in one comparatively long trip (50 to 100 miles) direct to the sites.

(5) *Adequacy of organic personnel for bridge construction.*—For any stream requiring two or more units of 25-ton equipage, organic personnel can furnish the working parties necessary to construct the bridge and handle all equipment. Where but one unit of equipage is needed, personnel of the bridge platoon can supply about half the personnel necessary for bridge construction. Greater experience and training in handling the heavier equipment is required than can be expected from combat engineer units usually available. Hence, the heavy ponton battalion may be charged with construction of the bridge, supplemented as and when necessary by general engineer troop units.

b. Primary duties will often permit employment of part of the men of the battalion to train their own and other engineer personnel, to reinforce engineer depot personnel, to maintain or repair roads near the ponton park, or to assist other nearby engineer units in performance of their duties.

c. Details of the 25-ton bridge, model 1940, and construction thereof are covered in TM 5-270 and in FM 5-10.

CHAPTER 7

RAILWAY AND INLAND WATERWAY UNITS

	Paragraphs
SECTION I. Organization of military railways and inland waterways, theater of operations.....	114-121
II. Railway units.....	122-126
III. Headquarters, inland waterways.....	127-130

SECTION I

ORGANIZATION OF MILITARY RAILWAYS AND INLAND WATERWAYS, THEATER OF OPERATIONS

■ 114. MILITARY RAILWAYS.—*a. General.*—For discussion of military railways in the theater of operations covering general provisions, reconnaissance, location, construction, maintenance, car loading, etc., see FM 5-10.

b. Organization.—(1) The standard railway system is divided into grand divisions, each under a general superintendent who reports to the manager, Military Railway Service. A grand division comprises two or more divisions, each operated and maintained by a railway operating battalion. A railway shop battalion, under a general shop superintendent, may serve two or more grand divisions. For command and administrative purposes, the general shop superintendent may report directly to the manager, Military Railway Service, or to the general superintendent in whose grand division the shops are located, as directed by the manager, Military Railway Service. This organization is shown in figure 22 (see also FM 5-10). The direct chain of command for any operating battalion, as shown in figure 22, is commanding general, theater of operations; commanding general, communications zone; engineer, communications zone; manager, Military Railway Service; general superintendent, railway grand division; superintendent, railway division. The chain of technical supervision and control for railway operation and maintenance is also shown in figure 22. Technical supervision and coordination between the various staff departments and subordinate units of the manager, Military Railway Service;

general superintendents, railway grand divisions; and superintendents, railway divisions and shops, although not indicated in figure 22, are essential.

(2) The organization shown in figure 22 follows generally that employed by commercial railways adapted to fit into the military organization.

c. *Traffic control.*—Exercised directly from GHQ to the railway grand division (or division) operating into and out of regulating stations by the regulating officer concerned, who operates directly under supervision of the assistant chief of staff, G-4, GHQ.

d. *Railway construction and reconstruction.*—In the communications zone and combat zone, as distinct from railway operation and maintenance, railway construction and reconstruction are carried out by general engineer troops under supervision of the engineer, communications zone, and army engineers, respectively. Technical supervision and coordination of railway construction projects is exercised by the chief engineer, theater of operations, and the railway section of his headquarters through the staffs of the engineer, communications zone, and the army engineers.

■ 115. **CHIEF ENGINEER.**—The chief engineer of the theater of operations exercises supervision over all military railway and inland waterway activities in the theater of operations (see TM 5-400). His office includes a railway and waterway section which coordinates all railway and inland waterway construction, strategic and tactical utilization, and collection and dissemination of statistics and intelligence in the theater of operations.

■ 116. **ENGINEER, COMMUNICATIONS ZONE.**—The engineer, communications zone, is responsible for construction on railways in the communications zone, and for operation and maintenance of all railways and inland waterways in the theater of operations. His headquarters includes a railway construction section and when necessary an inland waterway construction section.

■ 117. **ARMY ENGINEER.**—The army engineer is concerned only with railway construction in the army area that may be assigned to him by higher headquarters.

■ 118. **MANAGER, MILITARY RAILWAY SERVICE.**—The manager, Military Railway Service, reports to the engineer, communications zone, and is responsible for operation and maintenance of all military railways in the theater of operations. Control of all train movements into and out of regulating stations is exercised by regulating officers who are representatives of GHQ (see par. 8, TM 5-400). The Military Railway Service assigns train schedules and operates trains. The manager, Military Railway Service, is the first person in the chain of command in the theater of operations whose sole duty is operation and maintenance of railways. For details see TM 5-400, TM 5-405, and TM 5-410.

■ 119. **INLAND WATERWAYS.**—*a. General.*—Inland waterways include all navigable rivers and canals used principally for transportation of bulk supplies. They usually need little maintenance over short periods of military use but their capacity may be reduced and canalized streams may be rendered valueless by damage to lock structures and gates of dams. New construction on waterways after the advent of war will normally be limited to construction or improvement of terminal and freight handling facilities.

b. Employment.—To supplement railways and highways, inland waterways will be used whenever available. No rules applicable to all situations can be formulated. Nature of the water routes, distance supplies are to be transported, quantity and kinds of supplies, and military situation will determine the most effective form of organization and plan of operation.

c. Considerations involved.—An existing system of service may be put in operation in less time than would be required to construct a highway or railroad; each unit of equipment generally can carry more troops or material than rail or highway equipment; and complete destruction of a waterway is usually impracticable. However, water transport is slower than other methods; routes are subject to interruption by ice, bombing, accidents, floods, and droughts; and other means of land transportation may be required, one at each end of the water route, involving a transfer of loads each time.

d. Organization and operation.—Organization and operation of Inland Waterway Service headquarters and service are

similar to those of the Military Railway Service. For details see TM 5-400.

■ 120. **MANAGER, INLAND WATERWAY SERVICE.**—The manager, Inland Waterway Service, has duties and functions similar to those of the manager, Military Railway Service.

■ 121. **THEATER OF OPERATIONS.**—A typical theater of operations showing military railways and inland waterways is shown in figure 23.

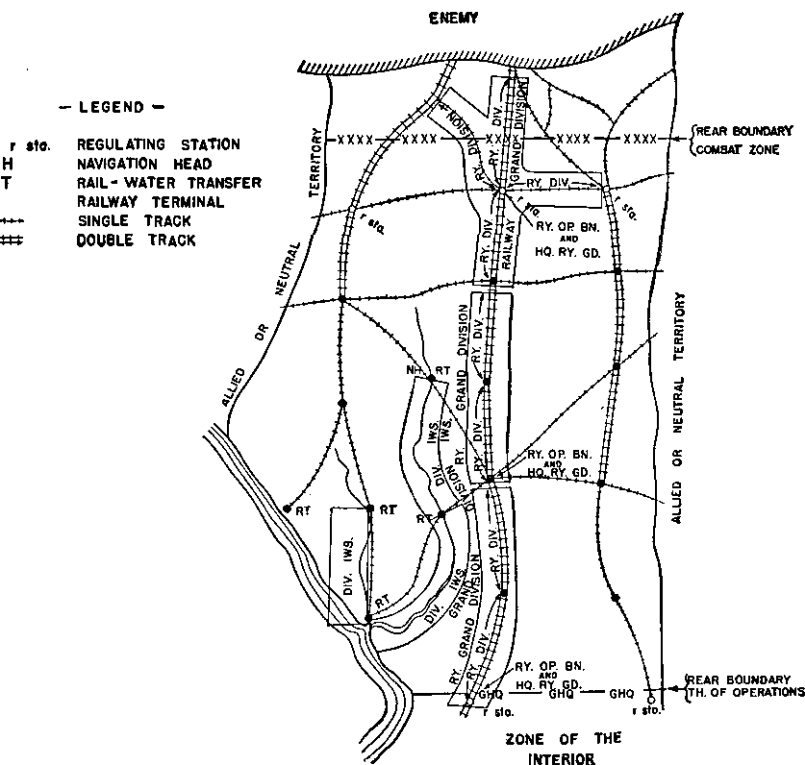


FIGURE 23.—Typical theater of operations showing military railways and inland waterways.

SECTION II

RAILWAY UNITS

■ **122. GENERAL.**—Personnel of engineer railway units are so far as available drawn from railways of the zone of the interior and from other specialists who perform duties in civil life similar to those expected of them in the military service.

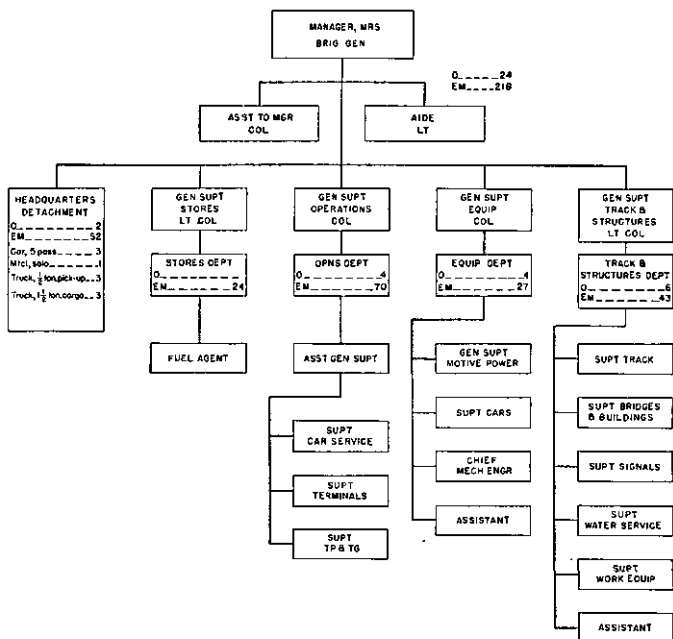


FIGURE 24.—Engineer headquarters, railway (T/O 5-302).

■ **123. HEADQUARTERS, RAILWAY.**—This unit comprises the manager, Military Railway Service, and his staff. Its organization is shown in figure 24. For details of organization and functions, see TM 5-400.

■ **124. HEADQUARTERS, RAILWAY GRAND DIVISION.**—*a.* The military railway system of the theater of operations is divided

for purposes of operation, maintenance, and administration into railway grand divisions and railway divisions (see figs. 22 and 23 and FM 5-10). Limits of a grand division are determined by the military situation, the traffic to be expected, and the geographical locations of lines and facilities, and will include two or more railway divisions. A railway shop battalion may be assigned to a grand division for heavy repairs to equipment.

b. Headquarters, railway grand division, exercises the functions of supervising and coordinating operations of several railway operating battalions, a railway shop battalion, and attached troops which have been combined into a railway grand division.

c. Like all railway units personnel of headquarters, railway grand division, will be composed of key men exercising functions similar to those they have exercised in organizations of railroads of the United States in time of peace, and other specialists recruited from men trained in civil life insofar as possible to do the work expected of them in the military service. This unit comprises the general superintendent, railway grand division, and his staff. Its organization is shown in figure 25. For details of organization and functions, see TM 5-400.

d. Railway traffic officers (RTO) from the staff of the general superintendent will be assigned to important stations to represent the railway superintendent of the division in which the station is located. They expedite movement of troops and supplies, have charge of all railway troops at the station, are responsible for condition and protection of the station, for prompt spotting of cars and their subsequent movement, and for all normal operations and reports of a railway station.

■ **125. RAILWAY OPERATING BATTALION.**—*a. Mission.*—The mission of the railway operating battalion is to operate trains and yards of a railway division, to maintain track and structures of the division, and to make running repairs to equipment. A railway operating battalion may also be assigned operation and maintenance of a large railway terminal or regulating station.

b. Limits of railway division.—The railway division is the primary administrative unit for operation and maintenance of standard railways. Limits of the railway division are such

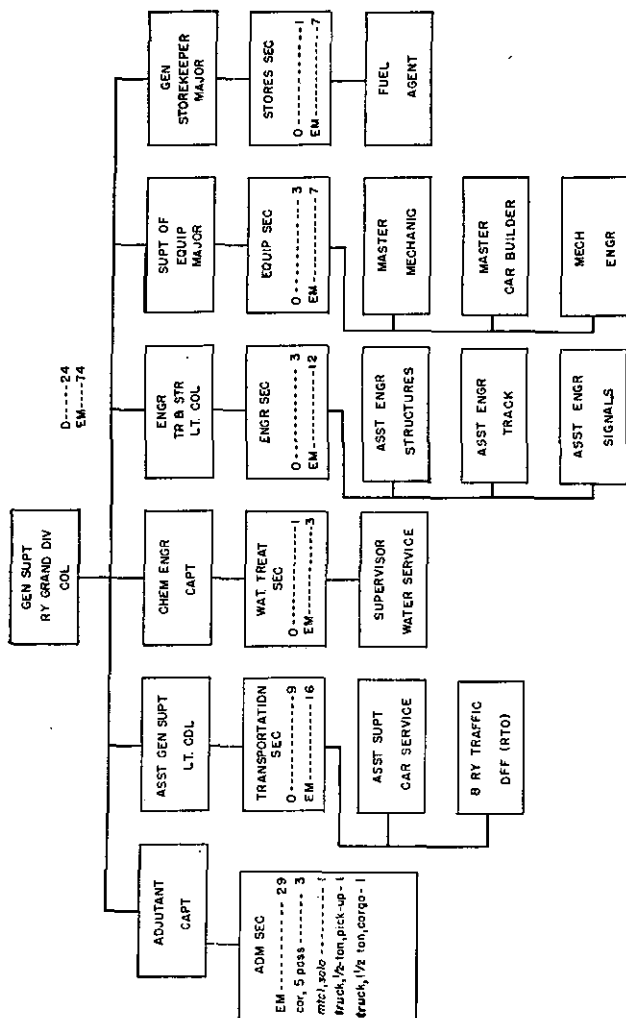


FIGURE 25.—Engineer headquarters, railway grand division (T/O 5-602).

that the division superintendent can maintain personal supervision over all activities on the division. Limits are determined by length of main line, number and location of branch lines, density of traffic, and terminal facilities; and should be such that the division superintendent can reach any point on his division within 8 hours. Length of a division may vary from 50 to 120 miles.

c. Organization.—The railway operating battalion consists of battalion headquarters, headquarters and service company, a maintenance of way company, a maintenance of equipment company, a transportation company, and a medical detachment organized as shown in figure 26 and table **XLI**, appendix **II**. For details of organization and functions, see **TM 5-405**.

d. Initial construction.—Initial construction of railways as distinguished from maintenance is not the duty of engineer railway battalions. Such work is normally done by general service regiments, assisted when necessary by engineer separate battalions or civilian labor. Use of railway battalions for work other than maintenance and operation of railways should be avoided. When an unavoidable situation requires their employment on other work, they must be provided with suitable transportation and equipment.

e. Additional personnel.—Additional personnel may be placed at the disposition of railway operating battalions for the purpose of increasing capacity of the railway. Such personnel may be civilians, general engineer troops, or troops of other arms and services when the latter are not available. Civilians or troop units are assigned to the various departments of the railway in accordance with needs. Civilians are attached to railway units and serve under the officers and noncommissioned officers of these units. Troops are employed under their own leaders, supervised by the appropriate officer of the railway service. The principal source of additional personnel is the engineer separate battalion. It is seldom necessary to attach more than one company of the separate battalion to a railway battalion.

f. Combat.—(1) The railway operating battalion will be used in combat only under the most extraordinary conditions. Railways are protected by combat troops located in the zone of operations of the railway. Where a line is subjected to

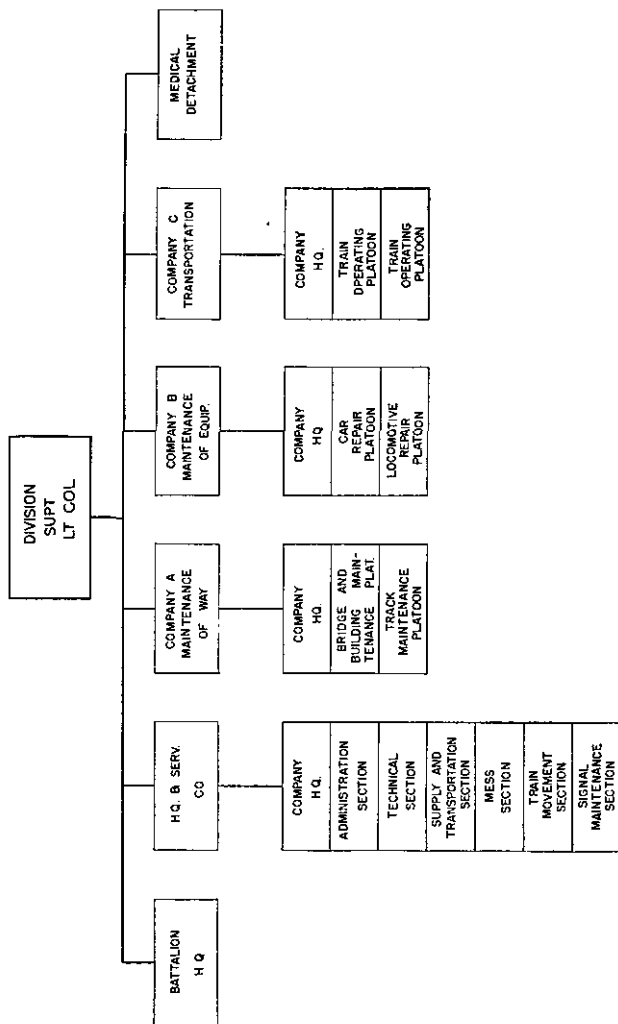


FIGURE 26.—Railway operating battalion (T/O 5-125).

frequent raids it may be protected by armored trains manned and commanded by personnel from other arms. The railway operating battalion provides train crews for armored trains. Movements of armored trains over a railway are governed by tactical considerations and may have priority of movement in an emergency.

(2) Combat training of railway operating battalions must be sufficient to give them confidence to meet any emergency, particularly for their own security from foot or mechanized raiding parties or from airplane attacks. When it is necessary for the railway battalion to enter combat it may be organized into a battalion of two rifle companies and one headquarters and service company and employed in accordance with fundamentals outlined in paragraphs 29 to 34. The transportation company (armed with pistol) is used to care for and protect railway equipment and material not in use, and to furnish replacements to the other companies.

■ 126. RAILWAY SHOP BATTALION.—*a. Mission.*—This unit handles heavy shopwork for several railway operating battalions. Its mission is to—

(1) Accomplish repairs to existing commercial or light standard equipment beyond capacity of railway operating battalions.

(2) Stock and furnish to railway operating battalions finished and semifinished parts as nearly prepared for application as practicable.

(3) Repair work equipment not permanently assigned to railway operating battalions or which is in need of repairs beyond their capacity to accomplish.

(4) Repair railway equipment assigned to the Coast Artillery Corps, Medical Department, or other arms and services.

b. Organization.—The railway shop battalion consists of a battalion headquarters, headquarters and service company, erecting and machine shop company, boiler and smith shop company, car repair company, and attached medical personnel, organized in general as shown in figure 27 and table XLII, appendix II. It is the basic unit for railway shop operations and may be expanded for operation of shops beyond capacity of the organization as shown. The type of railway

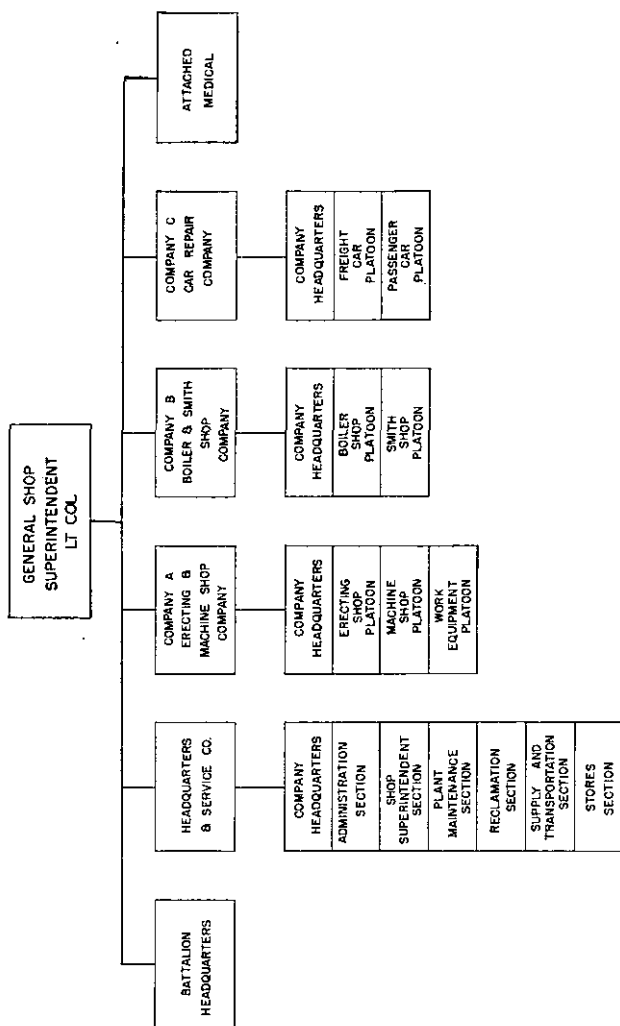


FIGURE 27.—Railway shop battalion (T/O 5-145).

equipment in use and actual operations may require modifications in the organization shown.

c. Initial operations.—Extensive repairs to railway equipment initially found in a theater of operations are not contemplated, but will probably have to be accomplished until sufficient standard military railway equipment can be put in service to relieve existing equipment. Initial operations therefore involve both heavy repairs to existing equipment and assembly and placing in service of such standard equipment as may be provided from time to time.

SECTION III

HEADQUARTERS, INLAND WATERWAYS

■ 127. GENERAL.—Headquarters, inland waterways (T/O 5-603), is a separate engineer staff which is organized to operate the Inland Waterway Service (IWS), either in the theater of operations or in the zone of the interior under instructions from the engineer section of higher headquarters. The Inland Waterway Service bears the same relation to the other arms and services as does the Military Railway Service (MRS). Its function is that of a general carrier. The status of inland waterways turned over for military use and their methods of operation are similar to those for military railways described in paragraph 114b.

■ 128. ORGANIZATION.—Organization of the Inland Waterway Service in general is in accordance with the doctrines governing military railway organization (see par. 114 and TM 5-400). Its headquarters organization (shown in figure 28) consists of a manager, Inland Waterway Service, a headquarters detachment, and four staff sections directed by superintendents of stores, operations, equipment, and channels and structures, respectively. Each staff officer has technical supervision over the activities of his department in subordinate units.

■ 129. OPERATIONS.—*a.* The manager reports to the engineer, communications zone. In a large system it will usually be necessary to divide the water routes into grand divisions and divisions. Length of grand divisions and divisions will vary more than on railways, and will depend upon relative

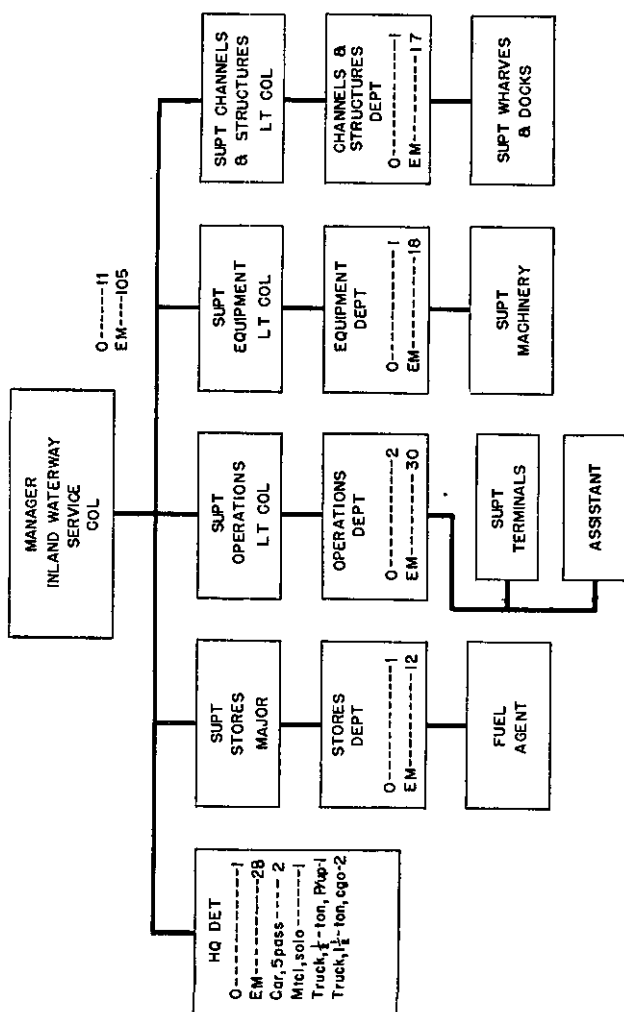


FIGURE 28.—Engineer headquarters, inland waterways (T/O 5-603).

geographical position of waterways utilized, their characteristics, length, importance, amount of traffic, ports, means available for supervision, and the military situation.

b. Plans for use and construction of inland waterway facilities will be prepared by the chief engineer, theater of operations. Under his technical control the various engineer headquarters of the communications zone and its sections are charged with actual construction of inland waterway facilities in the theater of operations.

c. Supplies are procured through the supply section of engineer headquarters, communications zone.

d. For further details of operations, see TM 5-400.

■ 130. TROOPS.—No Tables of Organization are provided for inland waterway troops. Upon recommendation of the manager, Inland Waterway Service, to the engineer, communications zone, GHQ will prescribe the engineer troop units to be organized for this service. Such troops normally will be organized into battalions similar to railway operating battalions, the duties of the three lettered companies being maintenance of channels and structures, maintenance of equipment, and transportation. Local pilots will be employed where available. Commercial navigation may be employed with military personnel for control.

CHAPTER 8

MAPPING UNITS

	Paragraphs
SECTION I. General-----	131-135
II. Corps topographic company-----	136-142
III. Army topographic battalion-----	143-151
IV. GHQ topographic battalion-----	152-154

SECTION I

GENERAL

■ 131. **ASSIGNMENT.**—Mapping units consist of the corps topographic company, the army topographic battalion, and the GHQ topographic battalion. For typical assignment to a balanced GHQ force, see table I, appendix II.

■ 132. **MISSIONS.**—In accordance with the basic requirement that field forces must be prepared to map as they move, production and reproduction of maps must be decentralized to the greatest extent possible. Hence mapping units are given general missions as follows:

a. GHQ topographic battalion.—The primary mission of this unit is reproduction at the outbreak of hostilities of existing maps of the theater of operations and of such other maps, sketches, and drawings of permanent character as may be prepared thereafter. Its reproduction functions approach those of a permanent establishment and its equipment will be relatively heavy and immobile. In addition to its reproduction function, it prepares maps by photogrammetrical methods as the situation requires and it may, if necessary, advance horizontal and vertical control to the zones of army topographic battalions. It may frequently be required to reinforce army topographic battalions. It may be called upon to make ground surveys for special installations such as camps and construction projects.

b. Army topographic battalion.—The primary mission of this unit is to provide map information adequate for tactical and strategical requirements of the army. It may reproduce existing medium scale maps, prepare various map substitutes

and battle maps, and establish and extend control. Sketches, drawings, and compilations are also provided for the army by this battalion. Detachments may be made to a corps operating on an independent mission. Its reproduction functions will probably be handicapped by greater time restrictions and lighter and more mobile equipment than in the case of the GHQ battalion.

c. Corps topographic company.—The primary mission of this unit is rapidly to prepare and provide map information, particularly the hasty types of map substitutes required initially by the corps, as compared with the slower and more accurate information at greater depths, both in our own and enemy territory, provided by the army battalion. Part of this mission involves increasing the density and extending the control needed for coordination of field artillery fire. In case of rapid movement or breakdown of map supply, it will also reproduce in one color on its portable equipment maps issued by higher headquarters. It is the smallest engineer unit with a topographic mission.

■ 133. CONTROL DATA FOR FIELD ARTILLERY.—It is the responsibility of the chief engineer, theater of operations, to furnish to field artillery, through the unit engineers of subordinate echelons, appropriate data concerning monuments, bench marks, and other control points in the artillery zone of action in form for use by artillery survey personnel. This requires close cooperation between field artillery survey sections and engineer mapping units of various echelons in order to eliminate unnecessary duplication in their respective tasks. If in any particular situation conflicts arise, the matter is one for decision by the higher commander of the major unit concerned who will adjust the differences so as to accomplish the work in the order of importance to the unit as a whole. Control points should be established where needed and control traverses should be carried forward in the proper direction. Initial or changed gun positions and targets and major changes in tactical dispositions must be anticipated and necessary control points and map data provided in advance of their need.

■ 134. TRAINING.—*a. Engineer.*—(1) *Personnel source.*—Personnel of mapping units is drawn insofar as possible from

existing military units and from personnel of Government agencies and private enterprises engaged in similar work.

(2) *Unit*.—Mapping units are trained in establishment of ground control, photogrammetry, topographical drafting and map compilation, map reproduction, and care and operation of the special equipment required for such work.

(3) *Joint*.—(a) Engineer mapping units and Air Corps photographic units participate jointly in mapping activities for training in use of wartime methods and for perfection of teamwork. This training consists of participation in maneuvers and all possible preliminary training in time of war prior to actual performance.

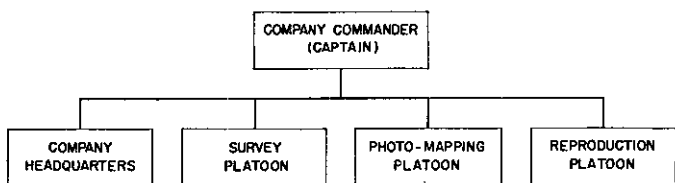


FIGURE 29.—Corps topographic company (T/O 5-167).

(b) Similarly, joint training of artillery survey personnel and mapping units of the various echelons is held whenever possible.

b. Basic, technical, and tactical.—For basic, technical, and tactical training, see sections V and VI, chapter 1.

c. References.—See appendixes for general references. For specific references for mapping units, see paragraph 1e appendix I.

■ 135. **COMBAT**.—See section VI, chapter 1.

SECTION II

CORPS TOPOGRAPHIC COMPANY

■ 136. **ORGANIZATION**.—The corps topographic company consists of a company headquarters, and survey, photomapping, and reproduction platoons organized as shown in figure 29 and table XLIII, appendix II.

■ 137. **COMPANY HEADQUARTERS**.—In addition to the personnel and duties described in paragraph 12, company headquarters

includes an additional officer as shown in table XLIII, appendix II, to relieve the company commander of administrative details. This leaves him free to direct the activities of the three platoons.

■ 138. **SURVEY PLATOON.**—The survey platoon is charged with execution and computation of ground control.

a. Organization.—The survey platoon, commanded by a lieutenant, includes topographic surveyors, topographical computers, instrument men, recorders, rodmen and chainmen, axmen, chauffeurs, and a clerk.

b. Equipment.—Equipment of the survey platoon includes theodolites, transits, levels, stadia and level rods, tapes, sketching sets, and miscellaneous surveying and computing equipment. The platoon itself can furnish a limited amount of transportation for survey parties, obtaining additional transportation from company headquarters as necessary.

c. Operations.—Personnel and equipment are sufficient to permit organization into triangulation, traverse, plane table, or level parties, in practically any combination desired or into several parties of one kind.

■ 139. **PHOTOMAPPING PLATOON.**—Compiles provisional maps of limited areas from photographs taken by corps aviation and prepares mosaics and other photomaps for reproduction.

a. Organization.—The photomapping platoon, commanded by a lieutenant, includes aerial phototopographers, draftsmen, computers, chauffeurs, and a clerk.

b. Equipment.—Equipment of the photomapping platoon includes stereocomparagraph sets, a photomapping set, and miscellaneous drafting equipment. Two 1½-ton trucks transport platoon equipment.

c. Operations.—This unit normally will be with company headquarters and the reproduction platoon near corps headquarters. It uses the slotted templet method and stereocomparagraphs for preparation of contoured sketches or maps from ground control and from aerial photographs. By these same methods it is possible to extend photographic control and photomapping into enemy territory.

■ 140. **REPRODUCTION PLATOON.**—Performs map reproduction functions of the company (see par. 132c).

a. Organization.—The reproduction platoon, commanded by a lieutenant, includes lithographers, photographers, copy cameramen, pressmen, water purification unit operators, and chauffeurs. It is organized for two-shift operation.

b. Equipment.—Equipment of the reproduction platoon includes mobile trailers fitted with a copying camera and 17-inch by 19-inch multilith presses, a black and white printing set, a duplicating set, miscellaneous reproduction equipment, and a water purification unit. The platoon has sufficient trucks to transport its own equipment.

c. Operations.—This platoon reproduces in required quantities the work produced by the photomapping platoon and existing maps and charts. It is centrally located in order to take advantage of existing distribution facilities.

■ 141. **EQUIPMENT.**—Technical equipment of the corps topographic company consists of surveying, photogrammetrical, and map reproduction equipment. It is characterized by its relative mobility compared to army and GHQ equipment.

■ 142. **OPERATIONS.**—Operations of the corps topographic company are covered generally in paragraph 132c and the preceding discussion of the several platoons of the company. The company operates under control of the corps engineer, and cooperates with the Air Corps observation squadron and the field artillery in the corps sector. Its function in providing control points for field artillery fire will be to carry forward the control provided by the army topographical battalion and to increase its density near the artillery areas so that it will be more readily available for field artillery survey sections of the corps and divisional field artillery.

SECTION III

ARMY TOPOGRAPHIC BATTALION

■ 143. **ORGANIZATION.**—The army topographic battalion consists of a battalion headquarters, a headquarters and service company, two survey companies, a photomapping company, a reproduction company, and attached medical personnel. Its organization, exclusive of medical personnel, is shown in figure 30 and table XLIV, appendix II.

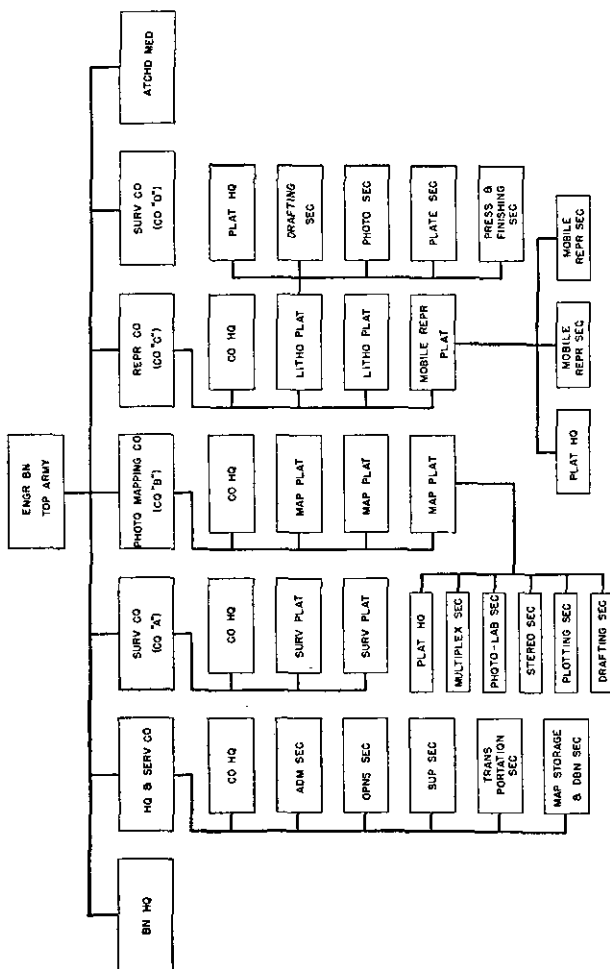


FIGURE 30.—Army topographic battalion (T/O 5-55).

■ 144. **BATTALION HEADQUARTERS.**—Battalion headquarters includes a lieutenant colonel commanding the battalion; a major, operations officer in charge of the operations section, and chief technical advisor to the battalion commander; a captain, assistant operations officer; and a captain, adjutant. For duties and functions of the staff see paragraph 11.

■ 145. **HEADQUARTERS AND SERVICE COMPANY** (see table XLV, app. II).—The headquarters and service company includes personnel, equipment, and transportation for administrative, operations, and supply functions of battalion headquarters and the company itself. Detailed organization and qualifications of the principal noncommissioned officers and specialists are given in T/O 5-56.

a. *Company headquarters.*—Includes the company commander (also battalion supply officer), a commissioned assistant, and enlisted men for company administration, mess, and supply.

b. *Administrative section.*—See paragraph 10b.

c. *Operations section.*—Under the battalion operations officer, includes topographic surveyors, topographic draftsmen, a map editor, and clerks who assist the operations officer in planning employment of the battalion and in preparing specifications for aerial photography. They also collect, evaluate, and file control data from outside sources, assist in initial stages of control establishment, prepare mapping specifications, make field checks, and edit all maps prepared in the battalion.

d. *Supply section.*—Under the battalion supply officer, includes a lieutenant, a battalion supply sergeant, an instrument repairman, a storekeeper, and clerks.

e. *Transportation section.*—Under a lieutenant, includes motor sergeants, auto mechanics, chauffeurs, and motorcyclists. It is charged with operation and maintenance of all motor transportation serving battalion headquarters and headquarters and service company.

f. *Map storage and distribution section.*—Under a lieutenant, includes a chief of section, a map supply record sergeant, and clerks. It orders supplies of, stores, and distributes finished maps, keeping records of all transactions.

■ 146. SURVEY COMPANY.—*a. Organization.*—The survey company comprises a company headquarters and two platoons, as shown in table XLVI, appendix II.

(1) *Company headquarters.*—The company headquarters consists of the company commander, two lieutenants, personnel for routine administration, mess, and supply, and topographic surveyors, topographical computers, draftsmen, an instrument repairman, and a record clerk. The company headquarters has, in addition to normal administrative responsibilities, the functions of planning and coordinating company work in accordance with assigned missions and making computations to complete control from field data obtained by the platoons.

(2) *Survey platoon.*—Each survey platoon is under the command of a lieutenant and contains a platoon headquarters, three survey squads, and a signal squad. Personnel includes a topographic surveyor, survey party chiefs, instrumentmen, recorders, rodmen, tapemen, riggers, a carpenter, and a record clerk. The platoon has a limited amount of transportation for equipment and survey parties; chauffeurs are furnished by company headquarters. Each of the survey squads includes a party chief, a transit party, a taping party, and a level party, and each has identical surveying equipment. In normal operation each squad is assigned a traverse and executes all field work connected therewith. For reconnaissance, triangulation, or plane table work one or more squads is assigned as required, and equipment for the purpose is obtained from company headquarters. Extra cooks may be attached and cavalry pack field ranges may be issued from company headquarters for work on distant missions. In triangulation work the signal squad assists by erecting towers and signals, clearing lines of sight, installing monuments, etc.

b. Operations.—The survey company's primary mission is establishment of control for mapping and its identification on air photographs. This is accomplished by traverse and triangulation. When use of the aerial photographic method of mapping is impracticable, the survey companies, in addition to establishing control, may be required to produce the map entirely by ground methods. On account of the slowness of the latter and its limitation to friendly territory, its employ-

ment should be regarded as an emergency method for small areas only. The surveying company pushes forward control as close as possible to the front. It may be made responsible for a frontal sector of from 10 to 15 miles.

■ 147. **PHOTOMAPPING COMPANY.**—This company makes maps by photogrammetrical methods from aerial photographs and ground control, the aerial photographs being furnished by the Air Corps and the ground control by the survey company.

a. Organization.—The company comprises a company headquarters and three mapping platoons as shown in table XLVII, appendix II. It is organized to operate in three shifts, a mapping platoon being assigned to each shift.

(1) *Company headquarters.*—Includes the company commander, two commissioned assistants and, in addition to personnel for routine administration, mess, and supply of the company, a technical group consisting of photogrammetrist, an aerial photographic laboratory technician, map editors, and topographical computers.

(2) *Mapping platoon.*—Each mapping platoon consists of a platoon headquarters, multiplex, photolaboratory, stereocomparagraph, plotting, and drafting sections.

(a) *Platoon headquarters.*—Consists of two officers, a photogrammetrist, and clerks. It coordinates work of the other sections of the platoon.

(b) *Multiplex section.*—Consists of aerial phototopographers. With its multiplex equipment it develops topography on the basis of ground control furnished by the survey company. The multiplex equipment allows extension of topography about 20 miles from an area of dense control with only moderate errors in position and elevation. Longer extensions are possible with less assured accuracy.

(c) *Photolaboratory section.*—Consists of aerial photographic laboratory technicians who prepare diapositives for use in the multiplex section of the platoon.

(d) *Stereocomparagraph section.*—Consists of aerial phototopographers and photogrammetrists. The stereocomparagraph is used to supplement the multiplex in plotting contours.

(e) *Plotting section.*—Consists of photogrammetrists, aerial phototopographers, and topographical draftsmen. It makes

projections and prepares control sheets for other sections of the platoon.

(f) *Drafting section*.—Consists of an aerial phototopographer and topographical draftsmen. It compiles or revises maps by assembling results of work completed by other sections of the platoon and preparing it for reproduction, including color separation drawings where required.

b. *Equipment*.—Its equipment consists of multiplex projectors, salzman projectors, stereocomparagraphs, and miscellaneous photogrammetrical equipment and supplies.

c. *Operations*.—Using the ground control furnished by the survey company and obtained by other means, and aerial photographs of territory behind and in advance of the front lines, the photomapping company makes up control sheets and fills in the detail by photogrammetrical methods.

■ 148. ARMY REPRODUCTION COMPANY.—a. *Organization*.—The company consists of a company headquarters, two lithographic platoons, and a mobile map reproduction platoon (see Table XLVIII, appendix II).

(1) *Company headquarters*.—Includes the company commander; his commissioned assistants, of whom one normally handles routine company administration, messing, supply, and operation and repair of transportation, and the other is the operations assistant for technical supervision of operations of the company; the enlisted personnel necessary for company routine; and technicians for supervision over and assistance to platoons of the company, including lithographers, electric plant operators, topographic draftsmen, and phototransferer lithographers.

(2) *Lithographic platoon*.—Each consists of a platoon headquarters, drafting, photographic, plate, and press and finishing sections.

(a) *Platoon headquarters*.—Consists of the officer in command of the platoon and a small technical and command group.

(b) *Drafting section*.—Executes drafting work of the battalion including lithodrafting, except compilation and color separation of maps prepared by the photomapping company.

(c) *Photographic section*.—Consists of photographic technicians, including wet plate and copy camera photographers,

retouchers, and printers. It is equipped to make wet plate and film negatives, contact prints in limited quantities, and ozalids or black and white prints.

(d) *Plate section*.—Consists of phototransferer, lithographers, lithographic draftsmen, and plate grainer operators. This section prepares lithographic plates.

(e) *Press and finishing section*.—Consists of rotary lithographic pressmen, a printer for preparing titles, place names, etc., a paper cutter, a paper folder, and a paper racker. This section reproduces maps on the rotary offset press.

(3) *Mobile reproduction platoon*.—Consists of a platoon headquarters and two mobile reproduction sections for two-shift operation.

(a) *Platoon headquarters*.—Consists of the officer in command of the platoon, operators of platoon motor transportation and accessories, a general lithographer, a map editor, a topographic draftsman, and a clerk. This section operates and maintains all automotive equipment of the platoon and supervises its technical operations.

(b) *Mobile reproduction sections*.—Each consists of general lithographers, rotary lithographic pressmen, lithographic and topographic draftsmen, photographers, retouchers, paper handlers, plate grainer, and water purification unit operators, and a general mechanic. These sections operate cameras and presses of the mobile reproduction train.

■ 149. ATTACHED MEDICAL.—Attached medical personnel have the normal duties of such a detachment (see par. 13).

■ 150. EQUIPMENT.—Equipment of the army topographic battalion consists of surveying, photogrammetrical, and map reproduction equipment. All equipment is mobile but relatively heavier than that of the corps topographic company.

■ 151. OPERATIONS.—a. The headquarters of the topographic battalion, the map reproduction company, and the photo-mapping company are normally located in the immediate vicinity of army headquarters to facilitate close coordination of command and staff functions in the formulation and execution of mapping operations which involve the army commander, G-2, the army engineer, artillery commander, and air officer.

b. Authority to make reproductions of any nature comes from the army headquarters. Requests for work are reviewed by the appropriate unit engineer. No work should be done without proper authorization.

c. The battalion commander obtains from G-2 all available maps of the area of proposed operations, and prepares plans for amplifying and correcting them. Data for correcting maps come largely from aerial photographs.

d. In early stages of operations staffs and advanced troops require maps at once. Immediate delivery is paramount even at a sacrifice of cartographic excellence. The painstaking and accurate methods of instrumental topographic surveying cannot produce maps of new areas with the necessary speed. The requirement is met by preparation of guide maps and correction of existing maps from airplane photographs. Gradually the necessary control work is accomplished and in successive issues maps can be published in more accurate form. Control includes recovery of established geodetic points or beginning a new system after base line measurement, triangulation, traverse, leveling, and accurate plotting of control points on the photographs in the field. This control is supplemented by additional control points to serve as the basis of control for field artillery fire. It is carried as close to the front as practicable and serves as a base upon which to construct, from aerial photographs, maps extending as deeply as possible into enemy territory. While the occupied area is the only area fully controlled and only limited control can be exercised through intersection of points in enemy territory, reasonably accurate maps may be prepared for some distance into enemy territory.

SECTION IV

GHQ TOPOGRAPHIC BATTALION

■ 152. ORGANIZATION.—The GHQ topographic battalion (see fig. 31 and table XLIX, App. II) consists of a battalion headquarters, headquarters and service company, a survey company, a photomapping company, a reproduction company, and attached medical, all of which except the reproduction company are identical in organization and equipment with

the corresponding units of the army topographic battalion (see sec. III). Therefore the reproduction company only will be discussed.

■ 153. GHQ REPRODUCTION COMPANY.—*a. Organization.*—The company consists of a company headquarters and three litho-

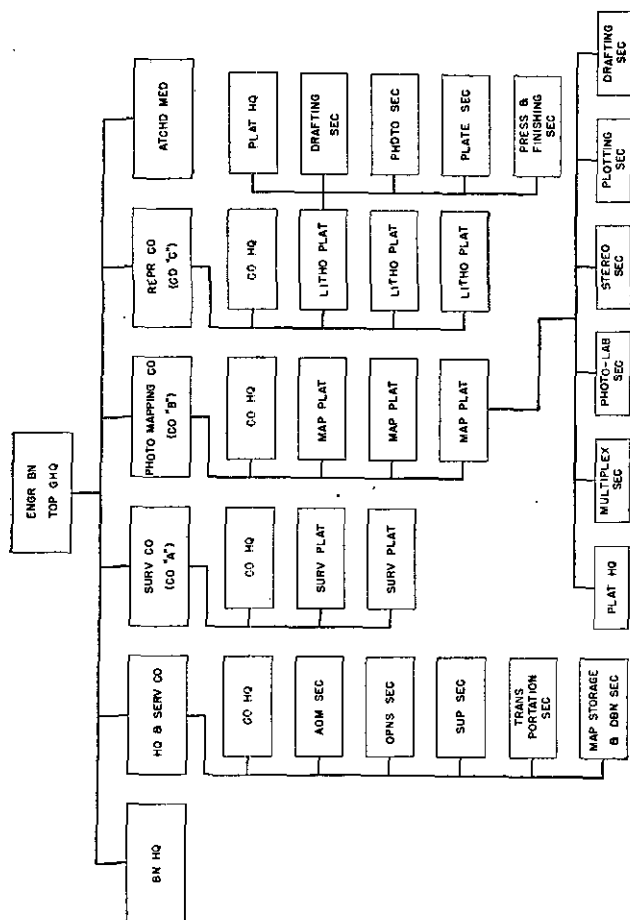


FIGURE 31.—GHQ topographic battalion (T/O 5-185).

graphic platoons for full 24-hour operation (see table L, App. II).

(1) *Company headquarters*.—Consists of the company commander; two commissioned assistants, of whom one handles company routine and the other is operations assistant; enlisted personnel for routine administration, mess, and supply; and a technical group, including a general lithographer, lithographic press erector, electric plant operator, map editors, and a map moulder who assist in technical supervision and operations of the company. The company has a limited amount of transportation.

(2) *Lithographic platoon*.—Each includes a platoon headquarters, drafting, photographic, plate, and press and finishing sections, all of which have organization, equipment, specialists, and duties similar to the corresponding units of the lithographic platoon of the reproduction company of the army topographic battalion (see par. 148).

b. *Equipment*.—Equipment of the GHQ reproduction company is similar to that of the army reproduction company, except that it has no mobile reproduction train and its equipment is generally larger and heavier. It is therefore much less mobile than the army battalion reproduction company. Whenever suitable lithographic plants exist in the vicinity of general headquarters they may be taken over and operated in place of setting up a new plant.

■ 154. OPERATIONS.—a. The GHQ topographic battalion normally is located near the general headquarters. It does surveying and mapping of areas within the communications zone and operates a base printing plant for the field force.

b. The headquarters and service company handles administration and supply of the battalion and the map stocks.

c. The surveying company and the photomapping company operate in a manner similar to the same units of the army topographic battalion except that in the communications zone there is less call for the cruder and more rapid methods and more demand for accurate work. The companies are called upon for general mapping, and for surveys of sites for camps and construction projects. The survey company from the GHQ topographic battalion may be used to supplement those of the army topographic battalions.

CHAPTER 9

SUPPLY UNITS

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SECTION I

GENERAL

■ 155. **GENERAL.**—Certain engineer troop units, both general and special, have certain supply functions in addition to their primary missions. The units discussed in this chapter are water supply battalion, depot company, mobile shop company, and dump truck company, the primary functions of which are of a supply nature.

SECTION II

WATER SUPPLY BATTALION

■ 156. **MISSION.**—The major mission of the water supply battalion is the purification and distribution of water. It may also be charged with developing sources and installing and operating water supply points in the absence of general engineer units.

■ 157. **ASSIGNMENT.**—*a.* Water supply battalions are assigned to field armies and the GHQ reserve as shown in table I, appendix II. Where there is an adequate distribution of water sources such as in the eastern part of the United States or in Europe, one water supply battalion can provide water requirements for an army. The number may be increased to two or more if adequate sources are sparsely located.

b. Water supply battalions assigned to the army are under command of the army engineer who usually exercises his control through a subordinate officer on his staff known as the army water supply officer.

■ 158. ORGANIZATION.—The water supply battalion consists of battalion headquarters, headquarters and service company, three lettered companies, and attached medical personnel as shown in figure 32 and table LI, appendix II.

■ 159. EQUIPMENT.—The water supply battalion is equipped to pump, purify, store, and transport water and has medical personnel to test the quality of the water. Equipment for installation of water supply points is also provided.

■ 160. TRANSPORTATION.—The water supply battalion is provided with sufficient motor vehicles for routine administration of the battalion, and for supervision of subordinate units while

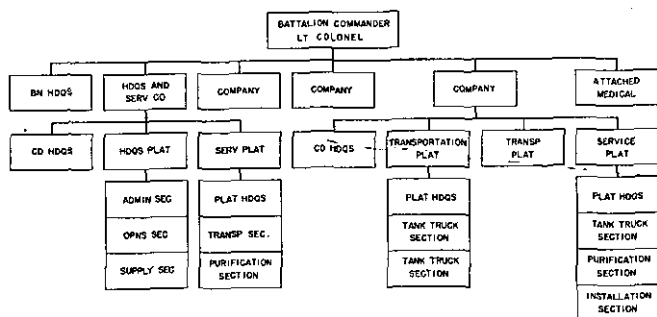


FIGURE 32.—Water supply battalion (T/O 5-65).

at work. For performance of its water transporting and purifying functions, the battalion contains 15 basic transportation units of six 750-gallon tank trucks each, and 9 purification truck units distributed as explained in paragraphs 164 and 165. The officers and men ride on the vehicles when the unit moves.

■ 161. TRAINING.—*a. Engineer.*—Water supply battalions are trained in operation and care of motor vehicles and special equipment assigned to the unit, in development of water resources, including installation of water supply points, in technique of water purification, and in water distribution over wide areas.

b. Basic, technical, and tactical.—See sections V and VI, chapter 1.

■ 162. COMBAT.—See paragraph 30.

■ 163. BATTALION HEADQUARTERS (see table LI, app. II).—Comprises the battalion commander and four members of his staff. Designations of his staff officers are executive, battalion adjutant, operations officer, supply officer, and surgeon. Their duties are in general as prescribed in paragraph 10b, except that the operations officer combines the duties of operations, intelligence, plans, and training. The operations officer has an assistant whose principal duty is concerned with compilation and distribution of water supply information.

■ 164. HEADQUARTERS AND SERVICE COMPANY (see table LII, app. II).—Headquarters and service company is an administrative and supply unit. It is not organized or equipped to transport water as are the lettered companies.

a. Organization.—See paragraphs 10c and 16b. This unit includes personnel for operating the various staff sections of the battalion headquarters, the supply service for the battalion, and the supervision and reinforcement of water supply operations.

b. Equipment.—Organizational equipment comprises that generally described in paragraph 16. The principal engineer equipment is listed in table LII, appendix II. Transportation is assigned to the transportation section except the six purification trucks which are assigned to the purification section. For description of the water purification truck, see paragraph 223, FM 5-10, and the operating instruction manual for the M3 water purification unit.

c. Company headquarters (see table LII, app. II).—Operates and is constituted as described in paragraph 12 a. The company commander is assisted by a commissioned officer who handles company administrative details.

d. Headquarters platoon.—Supplies enlisted personnel for battalion staff functions (see pars. 10b and c).

(1) *Administrative section.*—Includes clerical personnel making up the office of the battalion adjutant and operates under his direct charge. It handles routine administration, clerical work, mimeographing, postal service, and message center.

(2) *Operations section*.—Provides personnel for work under the operations officer and handles plans, orders, estimates, engineer reconnaissance, and inspections of engineer work.

(3) *Supply section*.—Provides personnel for operation of the battalion supply office. It operates under direction of the battalion supply officer.

e. Service platoon.—In addition to duties described in paragraph 10c contains a purification section which includes six basic water purification units of four men and one purification truck each. These units may be attached to reinforce the companies of the battalion or direct to tactical units as needed.

■ 165. WATER SUPPLY COMPANY.—*a. Organization*.—The company as the basic water supply unit is organized and equipped to procure, pump, transport, purify, and store water. Detailed organization and qualifications of the principal noncommissioned officers and specialists are given for subordinate company units in T/O 5-67.

b. Company headquarters (see table LIII, app. II).—Handles routine administration of the company and supervises operations of the two platoons (see par. 12a). In addition to the administrative personnel and chauffeurs for the company headquarters transportation, one staff sergeant is chief mechanic and motor inspector for the company. He is in charge of the motor repair truck and supervises training of platoon mechanics. The engineer equipment listed in table LIII, appendix II, is transported in the company headquarters cargo trucks.

c. Transportation platoon.—(1) *Platoon headquarters*.—Personnel operates its organic transportation, supervises mechanical condition of the platoon transportation, and supervises operations of the platoon.

(2) *Tank truck section*.—Basic water transportation unit. One chauffeur and an assistant chauffeur are provided for each tank truck. The section cares for, operates, and makes running repairs to its six tank trucks.

d. Service platoon.—Provides personnel and equipment for purification, pumping, and storage of water, and provides an

additional tank truck section for local distribution from a water source or to supplement the transportation platoon.

(1) *Platoon headquarters.*—Has personnel for supervision of the platoon operations and to operate any transportation that may be assigned to it.

(2) *Tank truck section.*—Organized and equipped essentially the same as the tank truck section of the transportation platoon.

(3) *Purification section.*—Operates one purification truck on a two-shift basis. It is supervised by a staff sergeant who is a water purification expert. The other enlisted personnel include a chauffeur for the purification truck, two enginemen for the pumping plant, and two filter operators. All personnel assigned to the purification truck are trained in its operation.

(4) *Installation section.*—Comprises a section sergeant and two installation squads. Each installation squad includes a corporal and necessary specialists for installation (carpenter, engineman, mechanic, canvas worker, water tender, and laborer). It installs and operates the water supply equipment (canvas basins and pumps) at temporary water supply points. Necessary tools and equipment for this work are obtained from the company and headquarters and service company.

■ 166. **ATTACHED MEDICAL.**—The medical detachment is similar in organization and duties to the medical detachment described in paragraph 13, and in addition is charged with analysis of the water provided for troops by the water supply battalion.

■ 167. **OPERATIONS.**—*a.* Commanders of troops of all arms are responsible that their units are provided with an adequate supply of water. When local supply is inadequate in quantity or quality, the battalion may develop additional facilities and it distributes and purifies water to meet minimum requirements of the command. Development of additional facilities, including installation and operation of water supply points, is a function of general engineer troops of all echelons. Water may be transported by railway tank cars to railheads and by the water supply battalion either from such railheads or from

water supply points to water distributing points, both of which are installed and operated by general engineers. Water distribution from such points to troops is a function of the using unit. For other water supply operations, see paragraph 273. For technical details, see FM 5-10.

b. The battalion has equipment for pumping, purifying, storing, and transporting water as shown in table I below:

TABLE I

	Gallons per minute		Gallons	
	Pump	Purify	Store	Transport
Headquarters and service.....	¹ 1,590	² 420	³ 55,560	-----
Company.....	² 100	⁴ 70	⁵ 22,500	22,500
Battalion (total).....	1,890	630	123,060	67,500

¹ 6 purification trucks used as simple pumps and 18 power pumps provided in water supply equipment.

² 1 purification truck used as a simple pump.

³ 6 purification trucks.

⁴ 1 purification truck.

⁵ In eighteen 3,000-gallon and six 260-gallon canvas basins of water supply equipment.

⁶ Storage capacity of tank trucks.

c. The water supply battalion may act as a unit or subdivisions thereof may be attached to other engineer units.

d. The company may operate under direct command of the battalion commander or may be attached to a corps or a division. It may also be attached to other engineer units to which water supply work has been delegated in a given area.

e. Employment of platoons of the water supply company depends upon the situation.

(1) The transportation platoon is equipped only for transportation of water but may operate its source of supply by attachment of an installation squad from the service platoon. It also may be equipped to purify water by attachment of a purification section from the service platoon or from the headquarters and service company.

(2) The service platoon has personnel for operating water sources as well as personnel and equipment for purifying and transporting water. It may be operated as a unit or sections thereof may be attached to transportation platoons.

(3) Two water supply units (to operate sources, purify, pump, and transport water) may be simultaneously formed in the company. One is formed by attaching the purification section and an installation squad from the service platoon to one transportation platoon. The other is made by combining a purification section from the headquarters and service company with the second installation squad from the service platoon and the second transportation platoon. In such cases the tank truck section of the service platoon would be attached as a whole or by subsections to one or both of the transportation platoons, or it may be given the separate mission of local supply of units near the water supply point.

f. Headquarters and service company is provided with water supply equipment and transportation to permit the battalion commander to increase the capacity of water supply companies if the situation demands. Water supply and water purification equipment may also be attached to corps or divisions without reducing working capacities of water supply companies. When purification units are attached to other units the purification truck is accompanied by its personnel.

SECTION III

DEPOT COMPANY

■ 168. GENERAL.—*a. Mission.*—The primary mission of this unit is the operation of engineer depots and other engineer supply agencies. It may form the nucleus of a large special engineer depot, or the engineer section of a general depot, or may operate a small engineer supply establishment. Depot sections or detachments therefrom may assist in operation of supply points in army service areas, or may be attached to corps (see ch. 11).

b. Assignment.—For normal assignment in a balanced GHQ force, see table I, appendix II.

c. Organization.—The depot company consists of a headquarters platoon and three depot platoons organized as shown in figure 33 and table LIV, appendix II. The basic operating

unit is the depot section of about 35 men. There are four such sections in the company.

d. Equipment.—(1) The organic equipment of the engineer depot company is sufficient to operate its various depot detachments. The company transportation consists of vehicles for routine company administration, handling supplies and operating equipment, and reconnaissance and inspection, but is insufficient for moving its personnel. The unit moves by rail or by trucks specially assigned by higher headquarters for the purpose.

(2) The equipment for depot operations includes standard engineer sets as listed in table LIV, appendix II, and special equipment, including a library of engineering handbooks and catalogs, and warehouse tools for receipt, inspection, account-

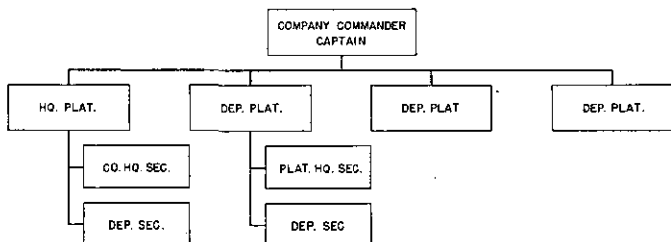


FIGURE 33.—Engineer depot company (T/O 5-47).

ing, care, storage, and shipment of engineer equipment and supplies.

e. Training.—(1) *Engineer.*—Depot companies are trained in methods of storage of all classes of engineer equipment and of those supplies of all arms and services needed for engineer work, and also in paper work involved in receipt, storage, and issue of equipment and supplies.

(2) *Basic, technical and tactical.*—See sections V and VI, chapter 1.

f. Combat.—See paragraph 30.

■ 169. HEADQUARTERS PLATOON.—*a. Company headquarters section.*—Organized and operated as described in paragraph 12a.

b. Depot section, headquarters platoon.—Used either in the operation of a part of a large depot in which the whole com-

pany may be engaged, or where the company is assigned to an area in which its platoons are dispersed on several supply installations, it may be assigned to the operation of one of these installations. Its organization is similar to the depot section of the depot platoon described below.

■ 170. **DEPOT PLATOON** (see fig. 33).—Suitable for employment in a portion of a large depot where it may handle several departments; for operation of a smaller engineer supply point such as an engineer railhead; or for attachment to a lower echelon such as a corps for operation of one or more dumps. However, it is not necessarily attached to the corps because of the fact that it operates supply points in the corps service area. Instead, administrative advisability governs its attachment in such cases.

a. Platoon headquarters section.—Includes the platoon commander and enlisted clerical personnel who handle the paper work at platoon headquarters and the clerical work of the depot or supply point to which the platoon may be assigned for operations. The section handles incoming requisitions, routing them to the proper place for supply, prepares outgoing requisitions for stockages, keeps note of supply levels and operates messenger service.

b. Depot section.—Includes a sergeant in charge of the section; a sergeant storekeeper who is charged with supervision over stocks kept in the depot or supply point; 4 corporals and 29 privates who do clerical work in connection with handling stocks, general warehousing, assembling of equipment, and general repairs to salvaged articles returned to the depot. This section handles supply items, making receipts and issues, classifying, salvaging, repairing, and guarding the engineer stores.

■ 171. **OPERATIONS.**—*a.* Depot companies may be employed anywhere in the theater of operations. When used in the larger depots of the communications zone where the tonnage of supplies handled is beyond the labor capacity of the depot company, civilian labor may be employed or additional troops may be detailed. When conditions warrant the assignment of a unit of general engineer troops such as a battalion to an engineer depot, together with a depot company, the usual plan of operation is to charge the commander of the general engi-

neer troop organization with sole responsibility for conduct of the depot and to attach the depot company to his organization for use as the depot overhead organization.

b. When depot companies are assigned to tactical service areas or commands for operation of engineer supply installations pertaining exclusively to the unit, they operate under the unit engineer (see par. 9). As a general rule, depot companies are charged with receipt, inspection, storage, and issue of engineer supplies. Normally, one company is assigned to the army service area and one company to each section of the communications zone. Additional depot companies from GHQ reserve will be attached as necessary.

c. In a war of movement the amount of the engineer supplies received from the rear by divisions, corps, and armies will be comparatively small but the collection of engineer supplies found locally within the areas may become of considerable extent and importance. Depots and similar establishments move by bounds. In an advance they are located and supplies accumulated as far forward as the tactical situation permits and the communication system affords distribution to the front. Depot platoons or detachments from depot companies may be assigned as necessary to assist in receipt and issue of such supplies. When the advance is resumed this depot personnel remains in the area and continues to administer these stores as directed by higher authority, usually the army engineer.

d. One engineer depot company can furnish personnel to handle a depot of about 300,000 square feet of storage area. The company commander organizes depot operations, assigning his depot platoons or sections to handling supplies by categories, namely, transportation, water supply, explosives, electrical supplies, lumber and shelter, technical equipment (surveying and drafting instruments, etc.), road building equipment, camouflage, field fortification supplies, etc. Supply operations of the company include receipt, storage, and issue; assembly and test of machinery; repair and restocking of salvage. The depot officer is not concerned with establishing priorities, that being a function of higher authority. He issues upon requisitions submitted according to the fundamentals outlined in chapter 11. He keeps his unit engineer informed at all times of the status of stocks and makes recom-

mendations designed to avoid accumulation of supplies not needed and to prevent exhaustion of stocks for which there is a great demand. He maintains a guard to prevent unauthorized tampering with depot stocks and prepares plans for removal and destruction of stores in event of withdrawal. Details of organization and operations of engineer supply establishments is covered in chapter 11.

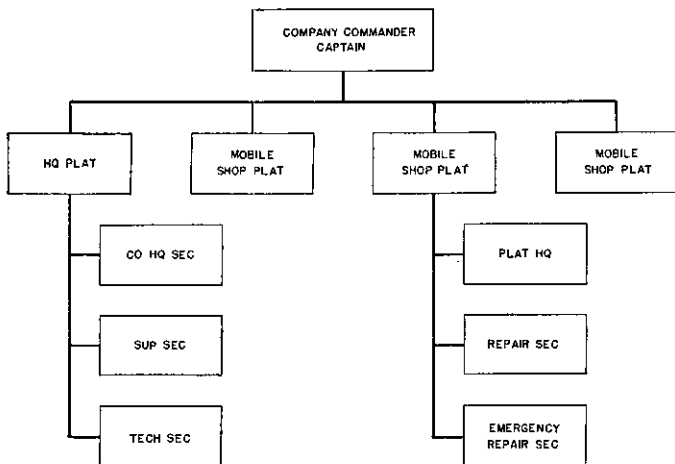


FIGURE 34.—Mobile shop company (T/O 5-157).

SECTION IV

MOBILE SHOP COMPANY

■ 172. GENERAL.—*a. Mission.*—The mission of the mobile shop company is to accomplish third echelon maintenance of all equipment for which the Corps of Engineers has maintenance responsibility.

b. Assignment.—The assignment of mobile shop companies in a GHQ force is given in table I, appendix II.

c. Organization.—The mobile shop company, as prescribed in T/O 5-157, consists of a headquarters platoon and three mobile shop platoons (see table LV, app. II, and fig. 34).

d. Equipment.—The company is equipped with such hand tools and small power tools as are normally required in the

repair of heavy equipment and it has certain machine tools in addition. All equipment is mobile, mounted on tool and bench trucks, machine shop trucks, welding trucks, and wrecking trucks. Spare parts trucks are also organic equipment. For purposes of messing, administration, and self-supply, the mobile shop company has the usual equipment and transportation (see pars. 16 and 18).

e. Training.—(1) Because of the specialized nature of the work on which this company is employed, it is essential that the provisions of paragraph 24 regarding initial selection of personnel, training of additional specialists, etc., be followed insofar as possible. This is not always possible. In any event, prior to assignment, personnel assigned should have demonstrated aptitude for mechanical work through standard Army aptitude tests. The unit commander should constantly train increasing numbers of personnel in all essential tasks, utilizing the apprentice system, in order that casualties will not cripple the work and that ready expansion may be made to meet military needs.

(2) Basic, technical, and tactical training is conducted as prescribed in paragraphs 20 to 28.

(3) Combat training for the mobile shop company is covered in paragraphs 29 and 30.

■ 173 HEADQUARTERS PLATOON.—*a.* Is charged with general coordination of work of the other platoons of the company and handles routine administration and supply of the company. Detailed organization and requisite qualifications for noncommissioned officers and specialists for this platoon and other subordinate units of the company are given in T/O 5-157.

b. Company headquarters section.—Includes the usual personnel for company administration, and routine (see par. 12a).

c. Supply section.—Includes a sergeant, storekeeper; a corporal, stock record clerk; a private, general clerk; and a chauffeur. It is charged with procurement of spare parts and all other necessities for shop operations.

d. Technical section.—Includes a master sergeant, master mechanic; a staff sergeant, general electrician; a corporal,

record clerk; and a private, toolmaker. It functions as an information agency on all technical matters for the entire company. It collects and disseminates information on repair methods, repair expediciencies, spare parts, etc. Its services are available as requested by using organizations to facilitate first and second echelon maintenance. Services of its technical specialists are rotated among the platoons to insure proper maintenance of equipment of the company.

■ 174. **MOBILE SHOP PLATOON.**—Includes a platoon headquarters, a repair section, and an emergency repair section which perform all actual maintenance tasks.

a. Platoon headquarters.—Includes a first lieutenant, platoon commander who should be experienced in equipment maintenance; a technical sergeant, mechanic foreman; a sergeant, storekeeper; and a corporal, record clerk. It controls and oversees operations of the platoon, insures supply of spare parts, and keeps necessary records of the maintenance work accomplished.

b. Repair section.—Commanded by a staff sergeant, general mechanic, and includes additional general mechanics, a blacksmith, a carpenter, general electricians, machinists, a carburetion mechanic, an ignition mechanic, and a welder. The section is equipped with such mobile repair units as machine shop truck, a tool and bench truck, a welding truck, and a spare parts truck, and performs tasks on all equipment which is brought to its temporary shop location.

(1) Machine shop truck is equipped with machine tools, including a lathe and a drill press.

(2) Tool and bench truck provides work benches and special mechanic's tools not included in individual mechanic's kits.

(3) Welding truck provides electric and acetylene welding and acetylene cutting facilities.

(4) Spare parts truck furnishes a wide variety of essential replacement parts.

c. Emergency repair section.—Includes a sergeant, general mechanic; two privates, general mechanics; and a chauffeur. It is equipped with an emergency repair truck and a wrecker truck so it can move to any point as needed within the area.

served. It makes repairs on the spot where possible; otherwise, it secures additional facilities from the repair section or it transports damaged equipment to the repair section.

■ 175. OPERATIONS.—*a.* Operations of the mobile shop company are characterized by its ability to maintain close contact with the units served and thus provide third echelon maintenance in forward areas. Emergency repair service is provided at the site of breakdowns.

b. Facilities available for conducting operations of the mobile shop company are truck-mounted and are independent of commercial power sources. Such sources may be used when available.

c. The mobile shop company is assigned to a field army. The company may be established as a unit or it may be decentralized to permit assigning mobile shop platoons to individual corps.

d. Facilities for fourth echelon maintenance will be provided by the organization of a shop unit with heavier and more complete shop equipment such as a heavy shop company or a heavy shop battalion. Such a shop unit, in conjunction with the mobile shop companies, will provide third and fourth echelon maintenance facilities similar to those of corresponding quartermaster units.

SECTION V

DUMP TRUCK COMPANY

■ 176. GENERAL.—*a. Mission.*—The primary mission of this unit is to transport road metal or other bulky materials in connection with engineer operations.

b. Assignment.—For assignment to a balanced GHQ force see table I, appendix II.

c. Organization.—The war strength dump truck company is organized generally as shown in figure 35 and table LVI, appendix II.

d. Equipment.—The principal equipment of the dump truck company consists of 1½-ton dump trucks. Nine trucks are provided for each dump truck section; 45 for the entire company. Organizational equipment is provided similar to that of the company (see par. 16).

e. Training.—Dump truck companies are trained in operation and care of motor vehicles, in delivery of material to working parties, and in handling motor convoys. For basic, technical, and tactical training, see sections V and VI, chapter 1.

f. Combat.—See paragraph 30. Use of dump truck companies in combat will be rare. Their training for combat will be principally with the rifle for their own security and for protection of their movements, and similar to training of infantry in this respect.

■ 177. HEADQUARTERS PLATOON.—This platoon is divided into a company headquarters and a dump truck section.

a. Company headquarters.—Consists of the company commander, a lieutenant, and the necessary enlisted personnel

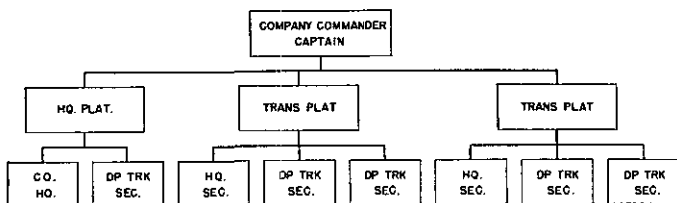


FIGURE 35.—Dump truck company (T/O 5-88).

for carrying on the functions described in paragraph 12*a*. For motor movements, three 1½-ton dump trucks, in addition to vehicles organically assigned to the company headquarters, are required for movement of rations and baggage, and for gas and oil.

b. Dump truck section.—Consists of enlisted men who operate nine 1½-ton dump trucks. It is commanded by a sergeant, truckmaster. The section provides one chauffeur for each truck and five spare chauffeurs. One of the privates of the section is an automobile mechanic and makes minor repairs to vehicles of the section.

■ 178. TRANSPORTATION PLATOON (see fig. 35).—*a. General.*—The transportation platoon is commanded by a commissioned officer and contains a headquarters section and two dump truck sections.

b. Headquarters section.—Includes a lieutenant, platoon commander; a staff sergeant, platoon leader; and two privates. This section provides the platoon commander with assistance necessary for supervising operations of the dump truck sections and maintenance of their vehicles.

c. Dump truck section.—Consists of a sergeant, truck-master, two corporals, nine chauffeurs (one for each dump truck), and five spare chauffeurs, one auto mechanic for minor repair work, and two basic privates.

■ 179. OPERATIONS.—*a.* Dump truck companies furnish transportation for movement of bulk materials in connection with engineer operations. In normal employment they are attached to organizations of general engineer troops engaged on road and railroad construction involving earth cuts and fills, bridges, and placing road metal and track ballast.

b. Determination of size of subdivision of a dump truck company to be assigned to a unit for a specific operation involving haulage must take into consideration not only cargo-carrying capacity of the trucks, but also capacity of the unit served to handle the material at both loading and receiving ends of the job. It must also take into consideration limitations imposed by the site of the work upon the number of trucks which can be used economically.

c. For operations the dump truck company frequently is broken up into platoons or sections and attached to general engineer troops distributed over a wide area. For such operations it may be impracticable for some of the elements to be fed and supplied by the company headquarters and these services must be performed by the units to which they are attached. In such cases the company headquarters functions are reduced to technical supervision of the various elements of the company as far as this may be practicable and desirable, and repair or exchange of equipment. When the company is divided, the headquarters platoon may itself be attached to a unit with or without transportation platoons or elements thereof. In such a case it normally should be attached to the unit to which the greatest proportion of the transportation of the company is to be attached.

CHAPTER 10

TROOP MOVEMENTS, SHELTERS AND CAMPS

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SECTION I

TROOP MOVEMENTS

■ 180. **GENERAL.**—A successful troop movement is one that places troops and their equipment at their destination at the proper time and in condition for effective work. This requires careful plans and preparations, and rigorous execution. For general information, see FM 100-5 and 25-10.

■ 181. **METHOD.**—*a.* Troop movements are made by marching by foot, by truck, rail, water, or air, or any combinations thereof.

b. All movements in the combat zone and shorter movements in rear of the combat zone are generally made by marching by foot and by truck. Trucks should be used whenever practicable to increase mobility and reduce fatigue of troops.

c. Longer movements in areas reasonably free from hostile air attack are generally by rail.

d. Movements by land are usually preferable to movements by water when an adequate land route exists.

e. Air movements are used for bodies of troops when time is the primary consideration, when destination is inaccessible to other means of transport, and for bodies of troops to be used for disrupting air, signal, and other enemy rear installations in support of a general offensive.

■ 182. **DEFINITIONS.**—*a. March unit.*—A tactical unit or group of tactical units under a single commander for purposes of march control. This term is applied to all types of units

whether foot, horse, or motor. For engineer foot troops the march unit is the battalion; for completely motorized engineer units, the company.

b. March column.—One or more march units, or serials, under a column commander and using the same route.

c. Serial.—One or more march units, preferably with similar mobility, placed under one commander for march purposes. Frequently serials are formed by combining elements of a command that are to travel at the same rate of march, as by combining foot, horse, and motor elements each in different serials. Serials should be numbered consecutively in their order of march from front to rear in columns, beginning with the column on the right. For example, if a command is to march in two columns and there are three serials in the right column, the leading serial in the left column will be number 4.

d. Initial point (IP).—A point at which a moving column is formed by the successive arrival thereat of its subdivisions.

e. Regulating point (RP).—An easily recognizable point where a motor transport column is separated into groups for entrucking and detrucking.

f. Entrucking point (EP) or detrucking point (DP).—Designated locality where the head of a group of trucks halts for the entrucking, or detrucking, of troops or supplies. If practicable, troops will be entrucked and detrucked in areas affording concealment.

g. Entrucking (detrucking) group.—Troops, material, and supplies entrucked (detrucked) at an entrucking (detrucking) point, including motor transportation used.

h. Shuttling.—Movement of troops, equipment, and supplies by truck involving one or more return trips.

i. Entraining (detraining) point.—Station or yard on a railroad at which troops are entrained (detrained).

■ 183. ORDERS FROM HIGHER COMMANDER.—*a.* Engineer units normally move either as a part of a large unit (for example, a combat battalion accompanying its division) or independently on order of a higher headquarters (for example, a corps combat regiment moving to a new work site on orders of its corps commander). In both instances the engineer

commander will receive orders for the move from the unit commander. These orders in the form of a five-paragraph field order generally cover such details as—

- (1) Kind of movement.
- (2) Time of starting.
- (3) Destination, or duration of move.
- (4) Route.
- (5) Location of IP or EP and route thereto.
- (6) Missions en route.
- (7) Instructions for engineer troops to be attached to other elements of the command.
- (8) Precautions as to secrecy and security.
- (9) Instructions for detachments left behind.
- (10) Instructions for trains, supply, and evacuation.
- (11) Other details requiring coordination by the higher commander.

b. When an engineer commander desires to move his unit on his own initiative he should request authority of his commander to prevent interference with movements of other units.

■ 184. RECONNAISSANCE.—a. Plans and orders for movement must be based on conditions affecting the movement. When it is made into an area not occupied by friendly troops or when friendly sources of information are inadequate necessary information must be obtained by reconnaissance. Ground reconnaissance is usually essential, although it may be materially assisted by air or map reconnaissance. Engineer units moving independently provide their own reconnaissance. Engineer units accompanying a large command usually make only engineer reconnaissance.

b. Engineer reconnaissance primarily is to determine the condition and capacity of routes, particularly those for motor transportation, and to find out what engineer work should be done to assist the movement.

■ 185. SECURITY.—Engineer troops moving in rear protected areas as a rule need security only against air attack. However, in a rapidly moving situation or in case of a hostile break-through measures must be taken to prevent surprise by armored groups. In proximity to the enemy, engineers

usually move in company with other troops who furnish necessary security against ground forces, the engineers furnishing their own security against air attack. Where engineers must provide their own security against ground forces, they do so as prescribed in FM 100-5.

■ 186. **SECURITY.**—Measures to insure secrecy for a movement are directed primarily against aerial observation. They include marching at night instead of in daylight, prohibitions on use of lights, taking cover when enemy airplanes appear, etc.

■ 187. **ENGINEER DECISIONS AND ORDERS.**—*a.* Orders of the higher commander must be supplemented by detailed decisions of the engineer commander.

b. Based on orders received and on information gained from reconnaissance, the engineer commander prepares a detailed plan as the basis of a march order in the general form of a field order. It is normally desirable to precede the march order with a warning order so that subordinate units can make preparations in advance.

■ 188. **PREPARATIONS.**—*a.* In preparing for the movement, allowance must be made for the time required for caring for engineer equipment. It often happens that engineer units have in their possession equipment issued to them for special work which it is not desirable or practicable to take with them to their new location. Arrangements must be made to turn over this equipment either to other using troops or to army or corps depots prior to the movement. Detachments from depot companies may be employed to take over these supplies.

b. Administrative preparation should insure that—

(1) Men, equipment, and motor vehicles are in the best possible condition.

(2) Units are properly equipped.

(3) Vehicles are properly loaded and serviced.

(4) Replenishment of supplies is provided for.

(5) Traffic control arrangements are complete.

(6) Provision is made for care and evacuation of sick and wounded.

■ 189. MARCHES BY FOOT.—*a. General.*—(1) Movements of foot troops normally include movement of their organic transportation. This transportation should be used whenever practicable to lighten the load on the individual by carrying as much of his personal equipment as the tactical situation and road capacity permit.

(2) Movement of organic and attached motor transportation of a unit moving on foot should be regulated so that the vehicles while moving, travel at their normal road speed and not at the speed of the foot troops. To accomplish this, motor transportation may precede the foot troops to the destination, or follow them at such a time interval as to arrive at the destination with or soon after the foot troops, or accompany them by moving by bounds, or move by a route other than that used by the foot troops. It is frequently desirable to break motor transportation up into two or more serials. In any case, motor movements should be so regulated that supplies and equipment carried thereby may be used to facilitate the march of foot troops and to assist them in execution of any assigned missions.

b. Orders.—The order for a march should cover all the following points that apply to the particular situation. They are listed below in the sequence followed in a five-paragraph field order:

(1) Information of the enemy and our own troops when advisable.

(2) Statement of object of the march, time of starting, route or routes, and destination.

(3) Detailed instructions for—

(a) Each march serial, to include such points as—

1. Location of, route to, and time of clearing IP.

2. Route of march.

3. March formation and rate of march to be used.

4. Position in march column and intervals to be maintained.

5. Missions en route.

6. Liaison.

7. Equipment to be carried.

(b) Subordinate units to be attached to the other commands, to include such points as—

1. Liaison to be established prior to attachment.
2. Time and place to report for attachment.
3. Missions while attached.
4. Supplies and equipment to be taken.
5. Duration of attachment.

(c) Precautions as to secrecy, security, and march discipline applicable to the command as a whole.

(4) Detailed instructions for supply and evacuation, to include such points as arrangements for—

(a) Supply of engineer materials needed to accomplish missions en route.

(b) Evacuation of casualties occurring during the march.

(5) Detailed instructions providing for maintenance of signal communications, to include such points as—

(a) Location of the commander, or place where messages will be sent in the march column.

(b) Location and time of opening of any temporary command post to be established during the march.

c. March table.—In the march order of the division or higher unit, certain of the instructions for the march are frequently incorporated in an annex to the field order called a march table. A form for a march table is given in FM 101-10.

d. Conduct of march.—(1) In starting the march the commander assembles his subordinate units in an appropriate formation and moves them to the initial point at such time and in such manner that there will be neither delay for other elements of the march column nor unnecessary waiting for his command at the initial point or elsewhere.

(2) On the march, rest halts are usually made during the last part of each hour; 15 minutes the first hour and 10 minutes thereafter. At these halts, men should get off their feet and rest as much as possible.

(3) Troops should drink all the water they need before starting and drink sparingly during the march. Water should come only from sources found safe by the medical service.

(4) The head of each march unit should maintain a steady, even pace at all times to prevent crowding or overextension at the rear.

(5) The engineer commander, and his staff ordinarily march at the head of the main body of engineer troops.

(6) Stragglers are either admitted to an ambulance by authority of the unit surgeon, or are taken in charge by a small guard marching at the tail of the unit.

(7) For protection against air attack troops break formation, take cover on both sides of the road, and then deliver rifle and machine-gun fire on attacking planes. As soon as attacking planes have passed, troops should be reformed and the march continued with minimum delay.

(8) Troops are not kept in column or under arms any longer than necessary, particularly during rest halts and on arrival at destination.

■ 190. MARCHES BY TRUCK (see also FM 25-10).—*a. General.*—

(1) The two major sources of trucks for moving troops are—

(a) Vehicles of the organization concerned. As some engineer units do not have transportation for all equipment and personnel at one time, movements depending on organic transportation only may involve shuttling.

(b) Vehicles assigned by higher headquarters. These may consist of quartermaster motor units of division, corps, or army, or of borrowed organic transportation of other units.

(2) In planning a movement by truck, the following particular points should be considered:

(a) Number of troops to be moved and amount of equipment and supplies.

(b) Transportation available.

(c) Distance or duration of the movement.

(d) Motor routes available.

(3) An engineer unit, whether moving independently or as part of a command, normally needs only one entrucking point for loading. When several units are included in one movement or when it is desirable to provide more than one entrucking point for a single unit as when the unit is scattered and there is not time for assembly prior to the move, the plan for loading should provide for—

(a) Regulating point (RP) where incoming truck column is divided into groups, one for each entrucking point.

(b) Entrucking points (EP) to which groups of trucks go from regulating point for loading.

(c) Initial point (IP) to which groups of loaded trucks go to be reformed into one column. The same general method is followed for unloading at detrucking points.

(4) Routes from RP to IP should be such that trucks do not have to turn around on a road or double back on incoming columns. When a choice exists, routes from RP to EP's and from EP's to IP should be chosen so that if a steep grade must be passed it is climbed when the trucks are empty. Whenever practicable, trucks should avoid passing through bivouac areas of troops not engaged in the movement.

(5) (a) Shuttling may be done in one of two ways, by having trucks make complete trips each time, keeping all entrucking points in the vicinity of the initial bivouac or assembly area; or by having trucks make partial trips after the first trip, marching troops to advanced entrucking points while trucks are moving initial loads. The first method ordinarily is preferable; the second method should be used only when saving time for the movement is of importance.

(b) For an engineer unit moving independently by shuttling in a rear protected area, the simplest procedure is first to move all vehicles to the destination with their organic cargoes; then to send back empty such vehicles as are needed to transport the foot troops. For an engineer unit accompanying a large command moving by shuttling, details of the move will be prescribed by the higher commander and may involve use of engineer transportation for moving other troops, if engineer work is not more important.

b. Orders.—The order for a movement by truck is similar in form and in general contents to the march order described in paragraph 189 *b*, with modifications of paragraph three to include RP's, EP's, routes of motor columns thereto and to IP's, and similar data pertaining to a truck movement covered above. When shuttling involving marching is used, orders should also cover instructions for troops marching from initial area to advanced EP's.

c. Entrucking tables.—When a truck movement involves use of several entrucking points, instructions for movement to the IP may be incorporated in an annex to the field order called an entrucking table. A form for an entrucking table is given in FM 101-10 and 25-10. Data for an entrucking

table is prepared most easily by using a computation sheet as given in FM 101-10 or 25-10.

d. Conduct of truck movement.—(1) Guides meet the incoming truck column at the RP and conduct trucks of each group to designated EP's. Each truck group usually halts at the RP for a short time to receive orders and pick up guides. After entrucking is completed, guides conduct truck groups to the IP.

(2) Trucks usually use the halt at the EP for inspection and servicing, for which 30 minutes ordinarily is allotted. The work of loading personnel and matériel is done concurrently. The latter is begun upon arrival of the trucks, but loading of troops should be timed so that they do not have to wait more than a few minutes before the trucks move out. Fifteen minutes is ample time for loading troops with their individual equipment; six minutes is enough for trained troops.

(3) On arrival at the EP, troops should be divided into groups of the proper size for truck loads and placed along the road so that each group will be near its truck. This should be done without interfering with other traffic on the road, and without exposing the troops unduly to air attack.

(4) When tactical considerations permit, truck columns may move at prescribed average rates of speed. The distance between trucks varies almost directly with the speed. Thus the time length of a column, that is, the time required for it to pass a given point, is about the same for all speeds. The rate of speed prescribed should suit type and condition of road, weather, etc. A long column, as for a regiment, operates most efficiently at speeds from 25 to 35 miles per hour on good roads, and from about 15 to 25 miles per hour on poor roads.

(5) A 15-minute halt is usually made at the end of the first hour to inspect trucks and loads, and permit men to relieve themselves; similar halts are made every 2 or 3 hours thereafter. Trucks close up with marching units when they halt.

(6) A truck which has to stop for any reason should move off the road. If unable to clear the road under its own power, it should be pushed off promptly by a following truck. If the truck is disabled so as to require major repairs, its load is

removed and transferred to an extra truck. If able to rejoin the convoy, it should fall in at the rear of the next marching unit that passes.

(7) Repair trucks and extra trucks for replacement purposes travel at the tail of the truck column. Disabled trucks which can be placed in running condition by minor repairs are repaired by the mechanics on the repair trucks and rejoin the convoy by proceeding at increased speed. Trucks requiring major repairs are towed by extra trucks to the convoy destination; if towing is impossible they are left alongside the road to be recovered as the situation permits.

(8) After detrucking, troops and matériel should be kept clear of the road until the empty trucks have cleared the detrucking point and following columns have passed.

■ 191. MOVEMENT BY RAIL.—*a. General.*—(1) Troop units are moved on standard trains of either type A or type B, consisting of the following kinds and numbers of cars:

Kinds of cars	Type A	Type B	To accommodate—
Coach.....	1	1	Officers.
Box ¹	18	9	Men, supplies, and equipment.
Flat.....	14	23	Vehicles.
Caboose.....	1	1	Train crew.
Total.....	34	34	

¹ 1 for use as a kitchen car.

Tactical units on any given train are usually accompanied by their organic and attached motor transportation and equipment on the same train. However, in some situations it may be desirable to have motor transportation of the units move by highway in order to reduce rail transportation requirements.

(2) Instructions relative to a rail movement, which generally come from army or higher headquarters, specify time movement is to begin or be completed, destination and future employment of unit, entraining and detraining points, and number of trains available for the movement. The com-

mander of a unit ordered to move by rail is especially concerned with orderly entrainment and detraining of his unit as scheduled with minimum inconvenience to the troops, security measures at entraining and detraining points and en route, and special supply and administrative arrangements required.

(3) The troop commander has no control over operation of trains. A railway traffic officer accompanies each train and is the intermediary between the commander of the troops carried on the train and railway personnel.

b. Orders.—The order for a rail movement is similar in form and general contents to the march order described in paragraph 189*b*, with modifications in the third paragraph to include entraining points, routes thereto, and entraining schedule.

c. Entraining table.—Instructions relative to trains and entraining groups may be incorporated in an annex to the field order called an entraining table. A form for an entraining table is given in FM 101-5.

d. Conduct of rail movement.—(1) An early reconnaissance should be made of entraining points to determine whether or not adequate loading facilities for vehicles and heavy equipment are available. If not available, they should be provided well in advance.

(2) Each company loads its own baggage and equipment. However, all motor vehicles should be loaded and all cooking equipment installed by one detail for the entire unit.

(3) Motor vehicles are secured against shifting by blocking wheels, strapping down axles, and inflating tires. See FM 25-10.

(4) Meals are cooked en route on field ranges installed in the kitchen car. Gasoline ranges must be secured to the floor of the car; wood ranges must be provided with bases of dirt held in place by shallow, tin-lined, wooden boxes.

(5) Three hours are sufficient for loading or unloading a train carrying both troops and motor vehicles or artillery. One hour is sufficient for troops alone.

■ 192. MOVEMENT BY WATER.—*a.* In general, troop movement by water involves movement of large bodies of troops overseas or coastwise, and since such movements are covered

in great detail by higher headquarters, the function of a unit commander is primarily administrative.

b. Ships are loaded in accordance with an embarkation order and schedule issued by the port commander upon which the troop commander's order for loading is based. Troops are marched or transported to the pier at the designated hour and are checked on board by name from previously furnished lists. Troops load their personal baggage, but normally their organization equipment is loaded by civilian labor in accordance with a detailed plan and prior to date of embarkation.

c. A commanding officer is designated for each transport who has command of all military personnel on board, except casual senior officers. This officer prescribes routine on board, posting of guards, etc. Each day, troop accommodations are inspected throughout, men are exercised and required to bathe, and bedding is aired. Boat and fire drills are held shortly after putting to sea and at least once a week thereafter.

d. Debarkation normally is under control of the commander of the port of debarkation or expeditionary force. Before debarking, each unit places a guide on the pier as directed by the debarkation officer; when troops debark they form on their unit guides. Troops leave the ship by unit or organization. They furnish details for policing the ship, removal of baggage, etc.

■ 193. MOVEMENT BY AIR.—a. The normal movement of engineer troops by air usually will be limited to movement of troops attached to Air Corps units and/or engaged in work on Air Corps facilities. Equipment and supplies accompanying the troops should be kept to the minimum consistent with accomplishing the mission. The squad is the basic troop load. Each airplane is loaded with the number of full squads it can carry; any excess capacity is then used for supplies, equipment, or command personnel.

b. Movement by air as part of a general offensive for the purpose of disrupting air installations and communications of vital importance to the enemy will involve a strong engineer complement.

SECTION II

SHELTERS AND CAMPS

■ 194. GENERAL.—*a.* Troops may be sheltered in any of the following ways:

(1) Bivouacs, in which troops rest on the ground, covered by shelter tents or hastily improvised shelter, or without any overhead cover.

(2) Camps, in which cover is provided by tentage more elaborate than shelter tents.

(3) Cantonments, in which shelter is provided by permanent or semipermanent buildings erected for that purpose.

(4) Billets, in which shelter is provided by public or private buildings, houses, etc., subject to certain restrictions of law.

b. That type of shelter should be selected which offers the most comfort and protection consistent with the tactical situation. Bivouacs are best for temporary occupancy, when troops must be held in readiness for action or movement in the near future. Camps and cantonments are best for rest areas, training centers, and concentration areas. Billeting affords excellent shelter immediately available and screens troops from hostile air observation, but troops in billets are not readily available for action,

■ 195. QUARTERING PARTIES.—Shelter areas, when not assigned by higher headquarters, should be selected in advance by a detail known as a quartering party, sent forward to select camp or bivouac sites or to locate billets. Members of the quartering party guide units to their areas on arrival, and may lay out vehicle parks, kitchens, latrines, bivouac areas for the men, etc., depending on time available and authority delegated to them.

■ 196. SELECTION OF CAMP AND BIVOUAC SITES.—*a.* From the standpoint of comfort and convenience, a camp or bivouac site should be selected which provides—

(1) Ample source of potable water, conveniently located.

(2) Good roads leading to, and easy communications within, the area.

(3) Room enough to accommodate the command without crowding.

(4) Dry ground sufficiently high and rolling to provide good drainage.

(5) Freedom from infection due to soil pollution, malarial mosquitoes, etc.

b. From the tactical standpoint, the following points should be considered:

(1) Expected duration of occupancy.

(2) Desirability of accommodating entire command in one area.

(3) Concealment and security.

(4) Availability of alternate sites to which units can move in case of gas attack.

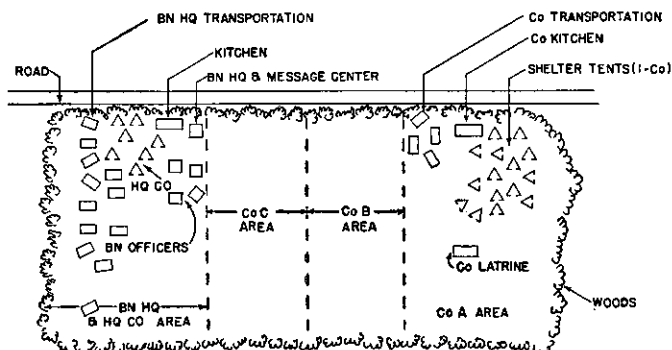


FIGURE 36.—Diagrammatic lay-out of battalion bivouac (not to scale).

■ 197. SECURITY.—a. General security of engineer units sheltered in areas subject to hostile ground attack usually will be provided by outposts and outguards furnished by other arms. However, each unit must furnish its own local security to protect against air attack and armored raiding parties, and must furnish its own local guard for vehicle parks, etc.

b. Engineer units sheltered in rear protected areas normally furnish their own local guard, and may be required to furnish their own local protection against air attack.

■ 198. BIVOUACS.—a. Location and lay-out of a bivouac depends primarily on the tactical situation. A typical lay-out is shown in figure 36.

(1) When troops are engaged in a movement bivouacs should be located close to or on the route being used. Where requirements of security permit they should roughly parallel the route of march so as to facilitate going into bivouac from the march column and leaving bivouac to form the march column.

(2) When troops are about to engage in operations, bivouacs should be located as conveniently to probable site of work as is possible.

(3) When subject to hostile air activity bivouacs should be located in natural cover such as woods. All units from the squad up should be prohibited from using any kind of regular pattern in laying out shelter tents or parking vehicles, and should be required to take full advantage of whatever overhead cover exists. New paths and roads within the bivouac should be located under cover and should be limited to those which are absolutely necessary.

(4) When bivouacs need not be concealed and there is no sacrifice of troop comfort, they may be located in open fields with a regular lay-out to facilitate control.

b. Sanitary measures must be initiated promptly, and must be strictly enforced (see FM 21-10).

(1) Latrines should be dug *immediately* on going into bivouac, normally providing one per company for men and one per battalion for officers. The latrine pit should be 1 foot wide and 4 feet deep. Length varies with number of men using it and length of time it will be used. Latrines should be located on the opposite side of the bivouac from kitchens, and sited so that drainage cannot pollute the water supply.

(2) Water supply facilities are set up as quickly as possible and troops informed thereof. Water, unless tested and found pure, must be chlorinated or boiled. If the source is a stream, watering places should be separated by purpose, beginning upstream, as follows: drinking, cooking, watering animals, bathing, washing clothes. Watering places should be marked clearly and guards posted to insure their proper use.

(3) A garbage disposal pit 4 feet square by 3 to 4 feet deep is dug for each kitchen. This is used for very wet garbage, dry garbage being burned.

c. Vehicle parks should be located so that vehicles can get in and out of the bivouac area quickly and easily, and without disturbing the troops. Parks should be sited on firm, well-drained ground, preferably where a turn-around is available so as to eliminate excessive backing.

d. The over-all area required to bivouac any particular unit can be estimated roughly by allowing 50 square yards per man or animal and 100 square yards per vehicle. These figures provide room for all essential facilities without crowding.

e. When evacuating a bivouac, the site should be policed thoroughly, all refuse burned or buried, latrine and garbage pits filled and posted with a sign giving date of closure and nature of the pit, and all fires extinguished. Each unit commander should inspect his area, and have any defects corrected before his unit leaves.

■ 199. CAMPS.—a. Standard tentage for camps consists of large pyramidal tents accommodating eight enlisted men each, and wall tents for the officers. When a camp is to be maintained for several months, floors may be provided if necessary materials are available. Folding cots or improvised lumber bunks are usually provided for all personnel. For cold weather each tent should be equipped with a stove.

b. Small camps of a temporary nature can be concealed in heavy woods by keeping everything under cover, by using an irregular lay-out, and by properly controlling use of paths and roads. It is practically impossible to conceal large camps; however, they will usually be located in rear areas protected by antiaircraft and passive air defense measures. When large camps are located in the open, they may have a regular lay-out in order to simplify erection of the camp and facilitate control of occupying troops. A typical lay-out for a regimental camp is shown in figure 37. The over-all area required for the camp for any unit can be estimated roughly by allowing 50 square yards per man or animal and 100 square yards per vehicle. These figures include allowances for roads, storage areas, etc., but do not include allowances for drill or athletic fields.

c. Extent of water supply and sanitary facilities provided for any camp depends on length of time it is to be occupied

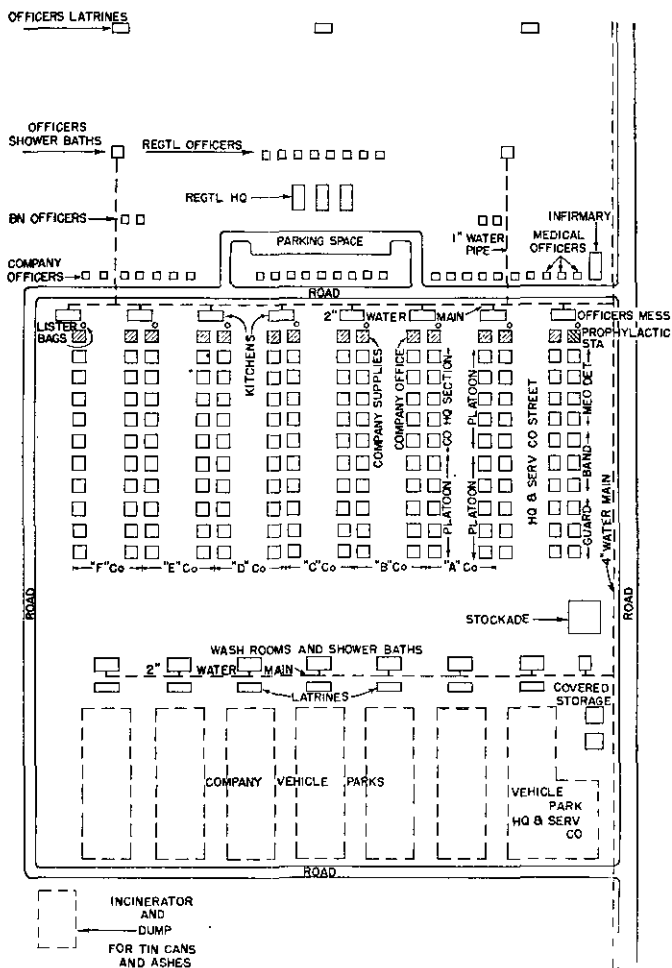


FIGURE 37.—Diagrammatic lay-out of regimental camp (not to scale).

and availability of necessary materials and supplies. These facilities may include running water for kitchens, bathing, etc., bathhouses, box latrines, limited electric lighting, and incinerators.

d. Tentage for troops is not a part of the organizational equipment. Necessary tentage is supplied from quartermaster depots on order of higher headquarters, which may erect and maintain camps for use by subordinate units or may turn over tentage to using units for erection. When a camp is preferable to bivouac but no tentage has been provided, the unit commander may requisition necessary tentage through higher headquarters.

■ 200. CANTONMENTS.—a. Shelter for troops in cantonments in the theater of operations normally consists of simple, one-story, frame buildings designed to accommodate 50 men. They are provided with wooden bunks for sleeping. Frame buildings are also provided for kitchens and mess halls, quarters for officers, latrines, bathhouses, etc. Facilities normally include running water for kitchens and bathhouses, electric lights, box latrines, incinerators, recreation buildings, hospitals, a substantial road net, athletic grounds, etc.

b. GHQ decides on construction and occupation of cantonments in the theater of operations. A unit ordered to a cantonment is assigned definite buildings which the unit commander reassigns to his subordinate units. It is desirable to assign organizations the size of a platoon and larger to separate buildings or groups of buildings.

■ 201. BILLETS.—a. Billeting in dwellings in the United States and possessions is limited by law so that in time of peace no troops can be quartered in a private house without consent of the owner, and in time of war only in a manner prescribed by law. However, available Federal buildings may be used or private buildings rented.

b. In assigning billets each tactical unit should be kept intact within one general locality to simplify control and administration. Existing facilities such as water, sewerage, light, and training areas should be utilized fully. It may be necessary to provide additional facilities such as latrines, garbage disposal, etc. Frequent medical inspections should be made and sanitary measures must be strictly enforced.

SECTION III

ENGINEER ASSISTANCE TO LARGE UNITS FOR
MOVEMENTS AND SHELTERS

■ 202. GENERAL.—*a.* Large units usually require engineer work to facilitate their movements and to assist in the occupation of new shelter areas. This work generally consists of—

(1) Providing facilities for and assistance in loading and unloading at entraining, embarkation, detraining, and debarkation points.

(2) Maintaining roads for movements by marching by foot and by truck.

(3) Preparations for receiving a unit at its destination.

(4) Providing or improving facilities in shelter areas.

To accomplish these tasks it is normally necessary to keep some engineer troops at the starting point until all or the bulk of the force has departed; to send other engineer troops to the destination before the bulk of the force arrives; and in some cases involving truck or rail movements, to have engineer troops accompany certain elements of the force during the movement.

b. In general, engineer assistance should be limited to work for the benefit of the command as a whole, or to work for which engineers are better trained and equipped than are the other troops. Other arms should provide their own facilities insofar as is practicable.

■ 203. ENTRAINING POINTS.—*a.* Work done by engineers at entraining points may include any or all of the following:

(1) Constructing or strengthening ramps and loading platforms for matériel, particularly for loads such as tanks and heavy artillery.

(2) Constructing or improving routes of approach for vehicles to entraining points.

(3) Constructing or improving railway spurs and sidings.

(4) Assisting troops or other arms in loading and securing heavy loads.

(5) Converting railway cars for special uses as modification of boxcars to accommodate animals.

b. Entraining points should be chosen so as to require minimum new construction or improvement. Work most

frequently required will be construction of loading ramps and platforms (see FTM 25-10). Loading facilities are of two general types, for side-loading and for end-loading.

(1) *Side-loading*.—A platform with a ramp at one end is constructed parallel to the railway track with a height above top of rail of 3 feet 9 inches, a clearance from center line of track of 6 feet, and a minimum width of 10 feet. The length of a platform for loading one flatcar at a time is 40 feet. Incline of the ramp should not exceed a 20 percent slope. Platforms and ramps may be built of timber or may be improvised, as from bales of hay or ties stacked in cribs and covered with a floor of ties or lumber, or from well-packed earth and revetted sides.

(2) *End-loading*.—A ramp is constructed at the end of a siding or spur or on a through track so that vehicles can load directly from the ramp to a flatcar. The gaps between adjacent flatcars in the train are bridged by spanning platforms made of steel plates or beams or by 3-inch by 12-inch planks 4 feet long cleated together on the under side and placed across the gaps under each tread. Ends of planks should be beveled. All vehicles then load from the end of the train and close up on the most forward flatcar until all flatcars are loaded. When the ramp is built on a through track, that part of the track which must be traversed by vehicles using the ramp should be decked with 6-inch by 6-inch lumber resting on the ties. Decking is laid parallel to the rails and should cover the ties both between and outside the rails. If lumber is not available, dirt or ballast may be used. Decking serves to protect rails from damage by tanks and other heavy vehicles, and to make use of the ramp easier for all vehicles. When loading heavy tanks the end of the flatcar next to the ramp should be supported on heavy blocks so that the impact created as the tank rocks forward onto the car from the ramp will not damage the car springs or truck. End-loading ramps may be built of lumber or stacked ties in the same manner as platform ramps. An end-loading ramp may be improvised by using a spare flatcar with the truck removed from one end for the incline; it is then necessary only to bridge the short gaps at each end of the incline. Railway car jacks facilitate raising and lowering the car to remove and replace the truck.

■ 204. EMBARKATION AND DEBARKATION POINTS.—These points normally will be located at ports with existing facilities generally adequate for military needs. Frequently no engineer work will be necessary at such ports; when required it will consist generally of minor repairs to existing wharves and improvement of existing routes of approach with little or no new construction.

■ 205. ROADS.—*a.* Movements by road involving either wheeled or track-laying transportation should be preceded, whenever the tactical situation permits, by a detailed reconnaissance by engineers of the route or routes available to determine their suitability for vehicles making the move. This reconnaissance should furnish complete information as to capacities of bridges, loads which roads can carry without injury to the surfacing, and density and speed of traffic which roads can bear without undue wear and tear. Based on this information the unit engineer concerned should make recommendations as to routes to be followed by various types of vehicles, maximum speeds to which vehicles should be restricted, amount of engineer work, if any, required to put routes in proper condition, and time required to perform this work.

b. Engineer work necessary to put roads in condition for a troop movement should wherever possible be completed before the move starts. Such work consists generally of strengthening existing bridges and making minor repairs to road surfacing. Routes should be chosen so as to eliminate need for new construction or extensive repairs.

c. When the tactical situation prohibits advance reconnaissance or work, sufficient engineer troops with their tools should accompany advance elements of the force to do whatever work is known to be necessary or is foreseen as probable. Likewise engineer troops with their tools should be located in the march column or columns so as to be readily available to do work which is beyond capacity of the engineers with advance elements, and to do any maintenance work made necessary as the force advances.

■ 206. WORK AT DESTINATION.—*a.* Troops moving by marching or truck should be able to move their organic and attached

transportation off the road and into their bivouac or similar area immediately on arrival at the destination. To permit this, engineers may have to construct temporary crossings over roadside ditches, gullies, etc., to improve secondary roads and trails, and to clear new trails.

b. At detraining points engineer work is similar to that at entraining points, consisting generally of constructing ramps and platforms for unloading vehicles, improving routes leading from detraining points, and assisting other troops in unloading heavy matériel.

c. Engineer work at embarkation and debarkation points will consist generally of minor repairs to and improvements of existing port facilities. However, troops, equipment, and materials suitable for the work at hand must be moved to the destination in ample time to complete the work before the bulk of the force arrives.

■ 207. SHELTER AREAS.—a. Engineer work in shelter areas consists of such of the following tasks (see FM 5-10) as apply in the particular situation:

(1) *Water supply.*—(a) Providing an adequate source, as by driving wells or damming a stream where no adequate supply exists.

(b) Installing and operating water purification units.

(c) Erecting and maintaining water storage facilities, varying from portable canvas tanks for bivouacs to permanent tanks of wood, steel, or concrete for cantonments.

(d) Preparing and operating watering points for men and animals, as when in bivouac.

(e) Installing and maintaining water mains and piping for camps and cantonments.

(2) *Roads.*—(a) Improving, constructing, and maintaining any roads, railroads, bridges, etc., needed for supply and communications within shelter areas.

(b) Providing and placing signs for traffic routing and control.

(3) *General construction.*—(a) Performing all construction and maintenance work for cantonments in the theater of operations.

(b) Erecting tent camps.

(4) *Electric power*.—(a) Installing and operating electric generating equipment for lighting or other use.

(b) Installing and maintaining electric power lines and wiring for lights, etc.

(5) *Special work*.—Constructing and maintaining such special works as camouflage and protected shelters for installations of special importance as directed by the force commander.

b. In all cases, full use should be made of existing facilities in order to reduce need for new construction. This applies particularly to water supply and electric power facilities, roads, and railroads.

CHAPTER 11

SUPPLY

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SECTION I

SUPPLIES AND SUPPLY SYSTEM

■ 208. **GENERAL.**—Organization of a theater of operations and administrative functions therein are prescribed in detail in FM 100-10 and 100-15. For supply definitions, see FM 100-10.

■ 209. **NATURE OF SUPPLIES.**—The Corps of Engineers is specifically charged within any theater of operations with procurement, storage, and issue of all engineer equipment, materials, and supplies required for use of engineer troops or for troops of other arms and services.

a. General.—General supplies are articles of standard manufacture and those stored and issued by two or more supply arms or services of the Army. They are procured by the Quartermaster Corps.

b. Special.—Special supplies are those special or technical articles in process of development or not commercially standardized issued or used exclusively by any one supply arm or service. They are procured and supplied to troops by the technical supply arms or services (Corps of Engineers, Signal Corps, Ordnance Department, Chemical Warfare Service, Air Corps, Medical Department). Included in these special supplies are those pertaining to the Corps of Engineers which are referred to ordinarily as engineer supplies. These supplies are officially enumerated in two lists known as the engineer procurement list and the engineer storage and issue list.

c. Engineer procurement list.—The engineer procurement list and the corresponding lists of the other supply services do

not directly concern officers in command of troops. The procurement lists merely effect a division of responsibility in the purchasing functions of the War Department and do not govern the responsibility of the supply services for supply of articles to troops.

d. Engineer storage and issue list.—(1) The engineer storage and issue list is divided into two parts. The first part designates articles and units of equipment stored and issued exclusively by the Corps of Engineers, and the second part designates articles procured by the other supply services which may be stored in limited quantities only by the Corps of Engineers to supplement assembly of units of equipment. The first part of the engineer storage and issue list includes all—

(a) Sets of equipment or supplies issued exclusively by the Corps of Engineers (listed in Tables of Basic Allowances as engineer equipment or supplies).

(b) Other supplies used exclusively by the Corps of Engineers.

(2) Due to the fact that in peacetime army construction work is not an engineer function construction plant and construction materials are absent from the list. In war however construction work in the theater of operations is a duty of engineers and engineers are charged specifically with procurement, storage, and issue of all materials for construction work, for organization of defensive systems, and for all other operations assigned to the engineer service, including all plant, tools, and appliances for such work. In the theater of operations therefore this large class of supplies is added.

■ 210. SUPPLY ITEMS.—*a. Engineer supplies.*—The engineer organizational equipment of troops is in class II, while the bulk of engineer construction materials is in class IV (see FM 100-10).

b. Troop equipment.—Standard items of engineer equipment are issued to troops of all arms and services in accordance with Tables of Basic Allowances. These items are for the most part sets of equipment similar to those issued to engineer troops (see Corps of Engineers Supply Catalog).

c. Supply items in division.—In addition to troop equipment, engineer supplies used in the division vary considerably both in kind and quantity, depending upon character

of operations in which the division is engaged. Principal requirements may be summed up as intrenching equipment, construction materials required for organization of the ground and for obstacles, camouflage material, materials for road building and maintenance, river crossing material, demolition equipment and supplies, and water supply equipment and supplies.

(1) *Intrenching equipment*.—Intrenching equipment, intended primarily for use of troops of the division in preparation of defensive positions, is carried as follows:

(a) Triangular infantry division, 3 infantry sets in six 1-ton trailers of the headquarters company of the engineer combat battalion (triangular division).

(b) Square infantry division, 6 infantry sets in twelve 1-ton trailers of the headquarters and service company of the engineer combat regiment (square division).

(c) Cavalry division, 4 cavalry sets in six 1-ton trailers of the headquarters and service troop of the engineer squadron.

(d) The headquarters and service company of the engineer combat regiment (corps) has 2 infantry sets carried on four 1-ton trailers which may be attached to divisions as necessary. This will be supplemented when necessary by additional equipment brought up from engineer depots.

(2) *Fortification supplies*.—Materials required for organization of the ground include trench revetment of various kinds, such as sandbags, wire netting, corrugated iron, expanded metal, brushwood, poles, etc.; trench boards, A-frames, trench pumps, materials for construction of dug-outs and mine galleries, principally lumber or concrete; and materials for construction of obstacles such as barbed wire and pickets. As organization of the ground progresses requirements in construction material for this class of work grow very rapidly.

(3) *Camouflage supplies*.—Some of the more important articles of camouflage supplies are osnaburg (or burlap), cotton cloth, camouflage nets, paints, paint-spraying machines, chicken wire and smooth wire rolls.

(4) *Road materials*.—Materials for road repair consist principally of crushed rock, gravel, plank, etc., obtained from

local resources to the greatest extent possible. Equipment carried by divisional engineer units for road work and local development of such supplies includes a power earth auger, tractors, and air compressors for drilling and other work. Heavier road equipment is obtained from rear echelons.

(5) *River crossing materials.*—Standard assault boats are carried in small quantities in the vehicles of divisional engineer units. Standard steel bridges, ferries, and ponton bridge equipage are carried in the vehicles of the armored battalion. Engineer units of higher echelons that may be attached to divisions as necessary carry assault boats, foot bridges, and ponton bridges. Bridge materials placed in dumps consist principally of light portable bridges to assist artillery over rough ground, bridge timbers, and bolts. All types of bridge materials and equipage are carried in engineer depots.

(6) *Demolition materials.*—Consist of TNT, caps, fuses, and accessories and are carried in limited quantities in the engineer trains. Additional quantities of TNT and dynamite may be obtained from higher echelons, army depots, or railheads.

d. *Supply items in higher echelons.*—Engineer supplies required by units in echelons higher than the division and located principally behind the division areas consist in general of units of engineer equipment, camouflage materials, fortification materials, and construction materials, the latter constituting a large portion of engineer supplies. They include road, railroad, building, electrical, water supply, mechanical, and bridge materials, etc., including equipment and tools for all types of construction work.

■ 211. SUPPLY IN ZONE OF THE INTERIOR.—a. The engineer supply functions of the zone of the interior are a responsibility of the Chief of Engineers and the immediate responsibility of the supply section of his office. This supply section is divided into five branches, requirements, storage and issue, procurement, supply information and engineering, development, and specifications.

b. For administration and command, engineer depots in the zone of the interior are part of the general depot system.

c. All requisitions originating either in the theater of operations or zone of the interior that must be acted on by the

Chief of Engineers are received by the requirements branch of the supply section where they are reviewed and approved for purchase or issue. Delivery is made from one of the depots or direct from manufacturer to destination.

■ 212. SUPPLY IN THEATER OF OPERATIONS.—Engineer equipment and materials must be made available for every military operation. The plans for engineer supply must fit into the general supply plan as prepared by the G-4 of the theater and approved by the theater commander.

a. *Supply responsibilities of unit engineers.*—To further decentralization of supply operations the unit engineer of every command is charged with responsibility for the engineer supply of that command. Under each unit engineer within the theater of operations agencies are provided whose primary duty is to provide for requirements of the troops of that unit in engineer equipment, material, and supplies. These supply agencies vary from a very limited personnel and a small amount of mobile supplies within the division to extensive depot and supply organizations in the army and communications zone. Figure 38 shows routing of requisitions and flow of supplies.

b. *Credits.*—As an aid in equitable distribution of material, in automatic check on waste, and as an assurance that supply will be certain, credits for engineer supplies may be given to the armies in communications zone depots and to corps or divisions in army depots. When such credits have been established there is no necessity for submission of formal requisitions but periodic notifications must be given as to items, quantities, and time of delivery (credits usually are established initially as the result of submission of requisitions by engineers of the communications zone and of the armies).

c. *Supply agencies.*—(1) *GHQ theater of operations.*—(a) The supply section of the office of the chief engineer, theater of operations, is an organization for control and planning. Actual supply operations are handled by engineers of the communications zone and of the armies.

(b) This supply section is concerned with determination of requirements in engineer supply, information of policies and priorities, and in allocation of equipment, materials, and

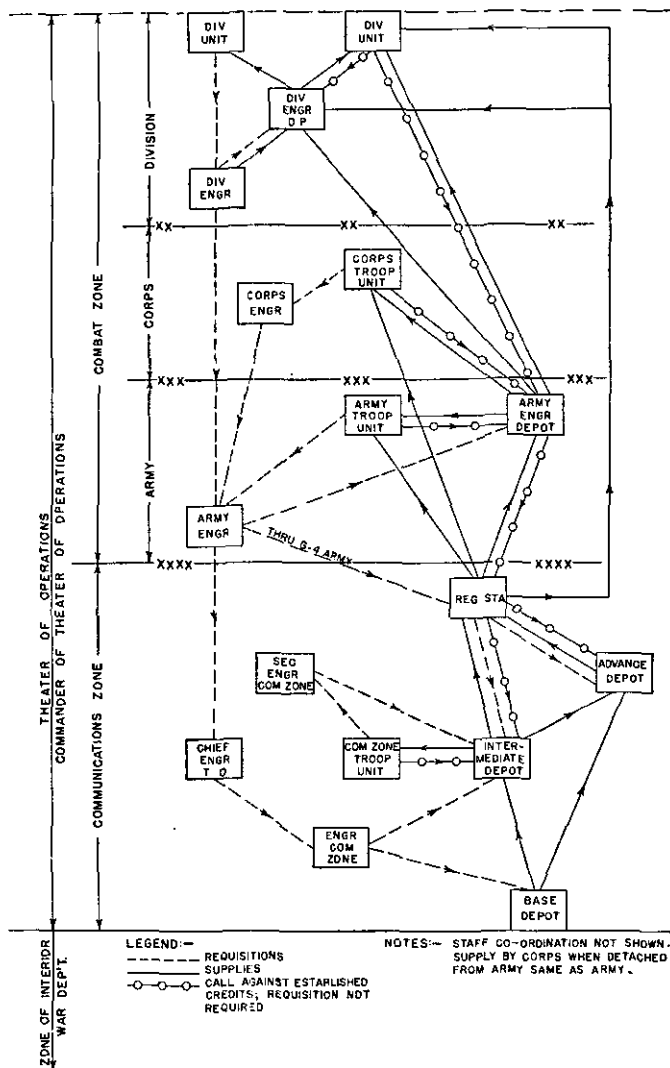


FIGURE 38.—Normal routing of requisitions and forwarding of engineer supplies in theater of operations.

supply between the several armies and the communications zone, consideration being had for general arrangements, policies, and directives of G-4. The functions of procurement, storage, and issue of engineer supplies are charged to the engineer of the communications zone.

(c) The supply section of the office of the chief engineer is generally organized into five branches; requirements, procurement, storage and issue, supply information, and engineering, development, and specifications. The requirements branch is responsible in general that all requirements of the theater of operations are estimated sufficiently in advance of need and with sufficient factors of safety to insure that all needs will be met. It establishes credits at depots and approves such requisitions as are required to be submitted directly to the chief engineer, theater of operations. The procurement branch supervises purchasing within the theater of operations. The storage and issue branch supervises the depot system of the Corps of Engineers of the entire theater of operations. The supply information branch will be organized upon mobilization to maintain and furnish statistics concerning purchase and delivery of equipment. The engineering, development and specifications branch investigates, designs, develops, and prepares necessary specifications and drawings for all items of engineer equipment for military use. It supervises activities of the Engineer Board and the Wright Field engineer detachment.

(2) *Communications zone.*—(a) The supply section of the office of the engineer, communications zone, is an operating agency as distinguished from the supply section of the office of the chief engineer, GHQ, which is a control and planning agency. The general character of the supply section of the office of the engineer, communications zone, is similar to that described above for the supply section of the office of the chief engineer, theater of operations. It exercises general control over supply activities of engineers of the various sections of the communications zone. The subdivisions of the supply section of the office of the engineer, communications zone, also maintain close liaison with the corresponding subdivisions of the chief engineer, theater of operations.

(b) Replenishment of all depot stocks both in the combat zone and in the communications zone as approved by the engineer, theater of operations, is the direct responsibility of the engineer, communications zone. Operation of engineer depots and supply activities in ports and sections (base, intermediate, and advance) of the communications zone when so divided may be placed directly under the section engineers within whose sections they lie.

(c) The supply officers of troops on engineer work operating under section engineers either submit requisitions to the section engineers or call directly at the nearest depot where they have been allotted credits.

(d) The supply section of the office of the engineer, communications zone, is generally organized into three branches: requirements, procurement, and storage and issue. The requirements branch is responsible that the estimate of requirements for all troops and projects of the Corps of Engineers in the communications zone is prepared sufficiently in advance of needs so that ample stocks can be built up in depots in time for issue when needed. It acts upon requisitions from the field, routing them to the storage and issue branch when stocks are on hand, on order, or en route to the theater of operations. If the supplies requested are not on hand, on order, or en route, the requirements branch makes requisition through the chief engineer, GHQ, upon the zone of interior, or if the supplies can be purchased within the theater of operations, on the procurement branch of the supply section of the engineer communications zone. The procurement branch makes purchases of supplies in the theater of operations in accordance with the procurement schedule furnished by the requirements branch. The storage and issue branch is responsible for storage of supplies and their issue upon requisitions from the field. Requisitions may be approved by the engineer, communications zone, or the issue may be a proper charge against credits established by authority of the engineer, communications zone.

(e) Engineer depot companies furnish the office and outside organizations for depot operation.

(3) *Army.*—(a) The army engineer of each army usually

will maintain and operate one or more engineer depots for engineer supply of troops of the army. The corps when part of an army is not a link in the chain of supply and evacuation except for corps troops. Its divisions are supplied directly from army supply points. When a corps is detached from the army for both operations and administration it becomes in effect a small army and must be considerably reinforced by additional service units because then it must perform supply and evacuation functions normally performed by the army.

(b) Depot companies provide personnel for operations of army depots. Platoons or sections may be detached from depot companies to take over forward engineer dumps when an advance is contemplated. When army supply activities are very extensive, general engineer troop units may be assigned to operation of depots.

(4) *Corps.*—(a) The corps engineer is responsible for the distribution of engineer supplies to corps troops only. In addition, when the corps is detached from the army he performs duties similar to those of an army engineer in supplying the divisions of the corps. He also exercises general supervision over supply to divisions, and assures himself that engineer supply to the divisions is adequate for the operations in view. He makes provision for relieving divisions of care of accumulated materials.

(b) The corps engineer in all situations is responsible for procurement, production, reproduction, and distribution of maps for divisions and corps troops.

(c) When the corps is detached from the army, personnel for operation of corps engineer supply establishments may be either depot companies attached by a higher echelon for the purpose, or general engineer troops.

(5) *Division.*—(a) The division engineer exercises his function as engineer supply officer of the division chiefly through the supply officer (S-4) of the divisional engineer unit. The intelligence officer (S-2) is charged with all matters concerning map supply. A small reserve of engineer materials and supplies is carried in the transport assigned to the divisional engineer unit.

(b) Supply activities of the division for troops of the division include—

1. Establishment and operation of engineer dumps, distributing points, and water supply points.
2. Procurement and distribution of maps and their production and reproduction within capabilities of the divisional engineer unit.

SECTION II

TRAINS

■ 213. DIVISIONAL TRAINS.—*a. General.*—Vehicles of the divisional engineer units, that is, the combat battalion (triangular infantry division), the combat regiment (square infantry division), the squadron (cavalry division), and the armored battalion (armored division), supplemented when necessary by vehicles of the divisional quartermaster unit or by corps vehicles attached, perform train functions for the division for engineer materials and equipment. The nature of engineer operations in the field makes it impracticable to classify permanently vehicles and cargo carriers of the divisional engineer units on a functional basis.

b. On march.—When the division is on the march distribution of engineer vehicles in the column must be determined for every march under the basic doctrine that equipment, tools, materials, and transportation must be available for work of engineer units as soon as the site of the work is reached. Some vehicles of the headquarters and service unit of the divisional engineer unit carry engineer equipment, tools, and materials for general use of the division and other supplies, need for which has been foreseen. Transportation to accompany the troops depends therefore upon the work that must be provided for during the march and immediately upon its termination. This involves a careful estimate of the situation.

c. Halts.—When the division halts, any or all transportation of the divisional engineer unit may operate as a train between the supply point for engineer supplies (army depot or rail-head) and the divisional engineer dumps and/or distributing

points. When on engineer work any or all transportation of the divisional engineer unit may be a work and supply train, since use of every available cargo carrier or any number thereof may be essential for handling materials for the work being performed. A careful estimate of each situation is essential.

■ 214. COMBAT BATTALION TRAINS, TRIANGULAR DIVISION.—

a. Headquarters company.—In the headquarters company certain vehicles normally accompany the unit or are readily available to it as they transport personnel and equipment essential to operation of the headquarters sections. These include light trucks and motorcycles for reconnaissance and messenger service, trucks and trailers carrying the electric lighting equipment, map reproduction equipment, and water supply equipment. Other trucks and trailers transporting equipment for regimental and divisional use for special work which may accompany the unit or not, depending upon the situation, include those carrying assault boats, supplementary equipment, intrenching tools, ammunition, and explosives. On the march these vehicles may be combined with other divisional transportation under division control when required by G-4. When an engagement is imminent or when this transportation is needed for engineer work, it should be released immediately to the division engineer.

b. Company.—In companies light trucks, motorcycles, dump and cargo trucks, trailers, and the company kitchen truck and trailer, together with such additional transportation as may be attached from the service platoon of headquarters company under special situations, constitute the train of the company. When the vehicles cannot go with the company they are nevertheless a part of its train and are disposed in the column so as to be readily available for work purposes. In some cases company trains or certain vehicles thereof may be grouped under S-4.

c. Platoon.—The platoon and squad transportation always accompanies the platoons and squads as it is essential to their engineer operations. In combat this transportation keeps

the platoon supplied with ammunition and other necessities from the appropriate supply point.

■ 215. COMBAT REGIMENT TRAINS, SQUARE DIVISION.—*a. General.*—Paragraph 214 relative to the headquarters company, company, and platoon of the combat battalion, triangular division, applies to the corresponding units of the combat regiment, square division.

b. Battalion.—In battalions no trains are permanently assigned. A portion of the transportation from the headquarters and service company may be attached to a battalion when needed. The battalion commander may pool company vehicles into a battalion train when the situation makes this desirable.

■ 216. SQUADRON TRAINS, CAVALRY DIVISION.—Paragraph 214 relative to the combat battalion, triangular division, applies to the squadron, cavalry division. However, the greater dispersion of the cavalry division generally will require that the organic transportation of each subdivision of the squadron be immediately available to it.

■ 217. ARMORED BATTALION TRAINS, ARMORED DIVISION.—Paragraph 214 relative to the combat battalion, triangular division, applies in general to the armored battalion, armored division. However, the accelerated pace at which movements and operations of the armored division are accomplished generally requires that the organic transportation of each subdivision of the battalion be immediately available to the subdivision. Pooling of vehicles is anticipated only when extraordinary operating conditions necessitate it.

■ 218. CORPS TRAINS.—Transportation of engineer supplies for corps engineer supply operations is accomplished by vehicles of corps engineer units supplemented when necessary by attached trucks of corps quartermaster or higher echelons.

■ 219. ARMY TRAINS.—Transportation required for army engineer supply operations is accomplished by vehicles of army engineer units supplemented when necessary by attached trucks of the army quartermaster or communications zone.

SECTION III

OPERATIONS

■ 220. GENERAL.—General precepts applying to engineer supply are—

a. Fit engineer supply into supply plan of the unit concerned. This implies—

(1) General coordination by G-4 of the unit.

(2) Flexibility of supply to meet contingencies.

(3) Establishment of priorities favoring main attack of the unit or defense of the most probable enemy attack when supplies are insufficient.

b. Limit number of supply items to the minimum. Difficulties of engineer supply vary directly with the number of supply items.

c. Exploit local resources to the utmost before requisitioning from the rear.

(1) As transportation is the bottleneck of the supply system and as engineer supplies are bulky, use local resources to reduce load on transportation and to increase efficiency of supply system.

(2) Open quarries and gravel pits, and reconnoiter for local sources of other engineer materials.

(3) Seize abandoned enemy supplies.

(4) Buy local supplies under proper regulations.

(5) Use expedients with local materials.

d. Minimize waste and reduce construction to bare necessities.

(1) Cut factors of safety.

(2) Use standard types.

e. Consider supply as a twofold function.

(1) Engineers of rear echelon supply agencies must have supplies available when and where needed.

(2) Unit engineers of forward echelons must estimate far enough ahead and ask for supplies needed.

f. Constant and thorough engineer reconnaissance is necessary to determine requirements in materials and supplies and availability and character of local sources of supply.

■ 221. PLANNING AND SUPERVISION.—*a.* A careful estimate of the supply situation is made by the unit engineer and his staff, considering present and prospective operations, general plan for supply of the unit, probable demands for engineer supplies, available transportation, and time element.

b. Based upon reconnaissance and estimate of the engineer supply situation, a plan of engineer supply is drawn up, approved by G-4 of the unit, and published in orders. The plan sets forth location of engineer supply points, character of items to be supplied therefrom, troops, engineer and others, to be engaged in engineer supply operations, and transportation to be allotted to supply agencies for movement of supplies.

c. In order that the supply plan may be successfully carried out, ample time for necessary preparations must be available. Preparations include assembling and inventory of stocks locally available, procurement and transportation of stocks from engineer supply points in the rear, and placing supplies near points of probable use.

d. The working of the supply system must be carefully supervised by the supply officer on the staff of each unit engineer. The supply officers of the several echelons maintain liaison among themselves with a view to rendering mutual assistance and making maximum use of available stocks of engineer supplies.

■ 222. DIVISIONAL RECONNAISSANCE.—Engineer reconnaissance is classified as *general* and *special*.

a. General reconnaissance is defined as the systematic search of an area for all engineering information of value, including information on engineer supplies and equipment in the area. Special reconnaissance is defined as the systematic search of an area for some particular kind of engineer information. It may be concerned with engineer supplies only.

b. General and special reconnaissances are duties of all engineer commanders in order to determine, among other things, location and quantity of all engineer supplies and those supplies of particular importance in the area assigned

to the unit. Such reconnaissance is carried on in accordance with the unit reconnaissance plan and standing orders on reconnaissance.

c. When battalions or companies of the divisional engineer unit are assigned to combat teams or are otherwise assigned to a part of the zone of action or sector of the division, they normally will be called upon by the divisional engineer headquarters to conduct general reconnaissance in their particular areas, and to conduct such special reconnaissances as are necessary.

d. In the usual case, in addition to the reconnaissance reports required of lower units, the divisional engineer headquarters will conduct special reconnaissances and may conduct general reconnaissances. Any areas not covered by lower units and areas of particular importance even though covered by lower units may be examined by general reconnaissances. Special reconnaissances to cover the entire zone of action of the division and to examine it for engineer supplies of particular importance to the division as a whole will be conducted in practically all situations. Special reconnaissance for engineer supply purposes normally will be carried out by the S-4 of the unit and personnel of his staff. However, any of the officers or key noncommissioned officers of the divisional engineer unit may be specially detailed for this important work.

e. It is evident from the above that no fixed rule can be laid down for all situations as to what reconnaissances will be conducted, by what units or headquarters they will be conducted, or how they will be conducted. These details will depend on the particular situation, but in all cases the reconnaissances must furnish full information of the supply of local engineer materials and abandoned enemy engineer supplies obtainable in the area to the engineer headquarters. While no set forms may be specified, a model form for reconnaissance for construction materials and equipment is shown below:

ENGINEER RECONNAISSANCE REPORT

CONSTRUCTION MATERIALS AND EQUIPMENT

Date.....	Party.....		
Map reference.....			
1. Area covered by reconnaissance.....			
2. Standing timber: General location if plentiful.....			
Specific location if scarce.....			
Range of sizes.....			
Accessibility from roads.....			
3. Lumber yards:	Location	Quantities	Cutting machinery
.....			
.....			
4. Hardware stores:	Location	General description of stock	
.....			
.....			
5. Gravel pits:	Location	Machinery at pit	Daily capacity
.....			
.....			
6. Quarries:	Location	Crushing machinery	Daily capacity
.....			
.....			
7. Brick yards: Location.....			
8. Road machinery:	Location	Number	
Plows:	.....	
Scrapers:	.....	
Rollers:	.....	
Concrete mixers:	.....	
9. Pile drivers: Location.....			
10. Barbed wire:	Location	Approximate quantity	
.....			
11. Additional materials or equipment:			
12. Remarks:			
Signature.....			
Grade.....			

■ 223. SUPPLY IN OFFENSIVE.—In the offensive, the principal items of engineer supply consist of materials for repair and maintenance of routes of communication. Road metal will be required in large quantities. It is procured from local quarries if possible, and is placed in convenient piles by the

sides of the roads most vital to the operation. Road plank is concentrated at dumps for use in making turn-outs around craters where use of alternate roads is impracticable. Bridge timbers are located near bridges which may possibly be destroyed by enemy fire or which may be strengthened for heavy loads. As the attack progresses dumps of engineer material are advanced. Captured supplies and local resources such as rock quarries and standing timber are exploited to the utmost in order that transportation over congested roads in rear of the attack may be kept to a minimum. This calls for active and persistent engineer reconnaissance of captured ground. As the divisions advance army engineers, utilizing personnel of depot companies, take over operation of engineer dumps which the divisions relinquish. They may assist division engineers by sending transportation and personnel for supply operations and by advancing materials from army supply points to the new dumps established by division engineers in captured territory. The engineers of all echelons prepare plans of supply for the attack as planned, and all eventualities such as organization of a defensive position, renewal of the attack, pursuit, or withdrawal or retirement. However, this is to insure timely meeting of a new situation and not the institution of stockages which will overload the means of supplying the basic operation.

■ 224. SUPPLY IN PURSUIT OR RAPID MOVEMENT.—The location of rapidly moving columns for supply purposes must be determined in advance. This is difficult and requires exacting staff work. Engineers must accompany such columns with loads of vitally necessary engineer supplies. Local materials and abandoned enemy supplies must be exploited to the utmost.

■ 225. SUPPLY IN DEFENSE.—a. When the defensive is assumed, intrenching tools and fortification supplies must reach the troops promptly. One or more engineer distributing points are established per division where supplies are delivered to using troops. Tools and supplies may be delivered direct to the battalion sector, the trucks checking through the distributing points. These engineer distributing points are located in the general vicinity of the regimental

reserve line, and near a good road on a good road net so as to be easily accessible to the battalion sector. An engineer dump and distributing point are usually established in the vicinity of the engineer bivouac area, stocked initially with supplies dumped by trucks of the divisional engineer unit. This supply point normally will be stocked with additional fortification materials, camouflage materials, and road plank. Other dumps and distributing points as required, in rear of artillery areas, similarly stocked, may be established in some situations. All these will be supplied from the engineer supply point by trucks of the divisional engineer unit, augmented when necessary by trucks of the divisional quartermaster unit.

b. Large quantities of road and camouflage materials are required. Road materials, except plank, are usually placed in separate dumps so as to be best distributed and placed for the work to be done. Road plank is stored at dumps of general supplies as well as near the site of the work as required.

c. The supply of antitank mines, employed mainly in defensive situations, is a special case. They are normally stocked and issued by the division ordnance officer from the ammunition supply points, based on allocations to units recommended by the division engineer in the same manner as ammunition (see par. 32). In special cases where the using units cannot go to the ammunition supply point, divisional engineers may stock antitank mines at engineer distributing points or even haul direct to the using units.

d. The unit engineers of all echelons prepare for resumption of the offensive or a withdrawal. If the offensive is to be resumed engineer supplies will be concentrated in army supply points located well forward and in the divisional areas. If a withdrawal is indicated the forward movement of supplies will be held to the minimum and stocks in forward supply points will be used up.

■ 226. SUPPLY IN WITHDRAWAL OR RETIREMENT.—a. In a retirement the troops continually move toward supplies previously concentrated. The principal supplies required will be for organization of selected defensive positions in the rear. The most difficult problem will be to evacuate supplies to the

rear. If a retrograde movement is possible or expected, supplies may be held on vehicles rather than placed in depots or dumps.

b. When the decision to withdraw has been reached, the quantity of supplies brought into the area is held to the minimum and every effort is made to use forward stocks.

c. Considerations governing removal or destruction of supplies are secrecy and noninterference with movement of combat troops by movements of trains. All supplies must be either used up, evacuated, or destroyed. Great care must be exercised in blowing up or burning dumps of supplies as this is a strong indication to the enemy of a contemplated retirement. The decision to destroy or abandon supplies is made by the commander of troops in the area, and a request is made by the unit engineer for such a decision early enough so that destruction can be accomplished.

■ 227. DIVISION OPERATIONS.—a. When the commander has announced his decision to undertake a course of action, the division engineer makes a supply estimate of the situation. He decides what, when, and where engineer supplies are needed and how he is going to place them there.

b. He checks this plan of engineer supply with G-4 for coordination, makes request for any divisional quartermaster or higher echelon trucks needed, and furnishes G-4 with such parts of his plan as should go into the administrative order of the division.

c. He then turns the plan over to his S-4 for execution and supervises engineer supply as the tactical situation unfolds.

d. The unit S-4 obtains additional personnel and equipment that may be necessary to carry on the supply operations from the headquarters and service company or headquarters company and combat companies.

e. Operation of engineer distributing points is the function of the supply officer (S-4) of the divisional engineer unit. For this purpose he utilizes the supply section of the headquarters platoon of the headquarters and service company of the combat regiment or the supply section of the headquarters company of the combat battalion, augmented as

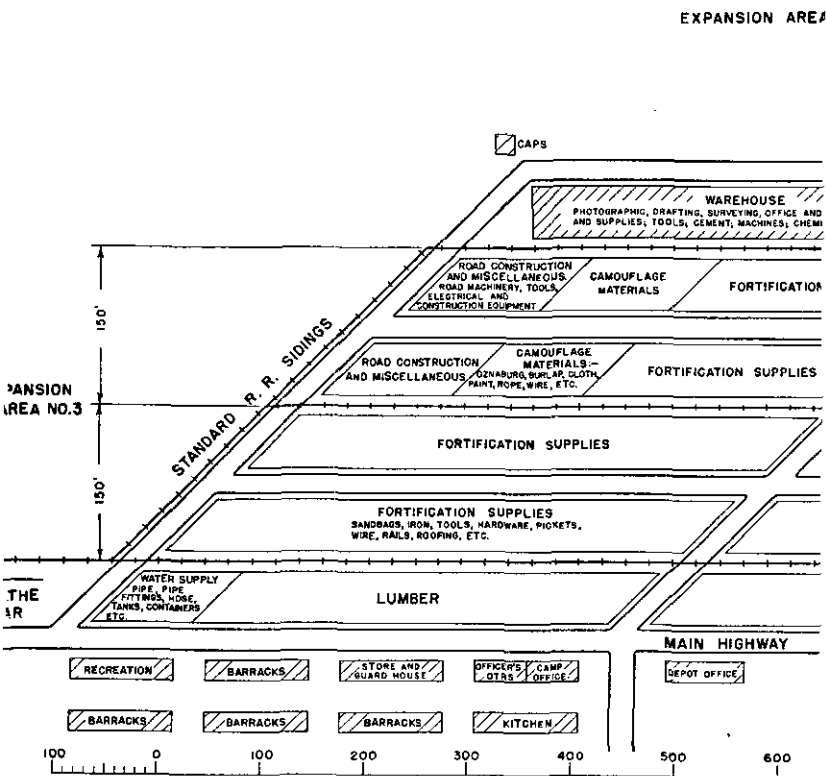
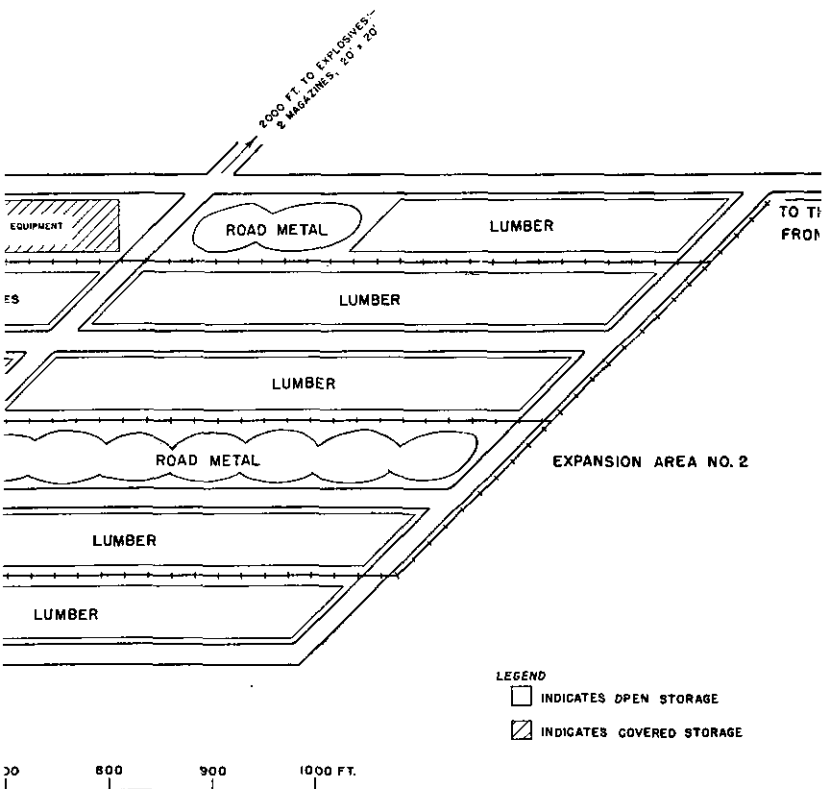


FIGURE 39.—Typical lay-out of army engineer depot in combat zone



showing communications, lay-out of stocks, and expansion areas.

necessary by qualified personnel from service elements of the headquarters and service company or the combat companies. A noncommissioned officer and two privates are normally sufficient for 24-hour operation of a divisional engineer distributing point. These establishments are handled without formality. Issues are made to troops of all arms, whether attached or belonging to a division, upon the statement of the commander that the supplies are necessary. A running account of stock is kept and studied to determine what items are available and what items are in demand. An orderly arrangement of stocks is maintained to promote efficient operation. Care is taken to disperse stocks and to camouflage distributing points. Bombproof shelter may be provided for personnel. It may be necessary to construct additional road facilities in and around distributing points.

■ 228. ARMY AND CORPS OPERATIONS.—*a. General.*—Corps and army engineer depots differ mainly in size. Since the corps when detached from the army becomes in effect a small army (see par. 212c (3)), and operates on the same lines as the army, only operations of the army engineer for supply will be discussed.

b. Army engineer operations.—Operations of the army engineer for supply are as follows:

(1) Confers with G-4 of the army on tactical requirements and general plan of supply and evacuation.

(2) Draws up lists of necessary items well in advance of needs.

(3) Requisitions items from the engineer of the theater of operations who may approve same for immediate issue or may direct that credits be allotted in communication zone depots. Copies of the requisitions go through G-4 of the army to the regulating officer for the army.

(4) Supplies normally are shipped from depots through the regulating officer, to army engineer depots or railheads.

(5) When supplies arrive they are disposed of in accordance with the tactical plan and general plan of supply and evacuation of the army.

(a) In a mobile situation depots may be established when they can be placed far enough forward to supply the con-

templated operations, or all or a part of the supplies may be kept mobile on railroad cars or motor vehicles.

(b) In a static situation depots normally will be established.

(c) Troops needing supplies at once are issued them immediately on call.

(d) If supplies are needed at once by troops who cannot call for them immediately, forward dumps for the lower units are established by the army.

(6) Supplies will be issued on requisitions from divisions or by setting up credits for them in army engineer depots.

(7) Continued adequacy of supplies to comply with the general plans of the army must be assured. This is done by careful estimates of anticipated requirements and checks of stocks on hand, in depots, and in the hands of subordinate units. The time lag in obtaining supplies must be taken into account.

(8) Proposed depot locations are recommended to army G-4, and established when approved.

(9) Requirements of a depot are—

(a) Siding capacity for at least one standard railroad train.

(b) Good motor road facilities. It usually will be necessary to construct additional roads in and around depots.

(c) Out of range of enemy artillery fire.

(d) Centrally located, well forward or so as to best favor the contemplated operations. Army depots usually are located in rear part of the army area.

(e) Covered (about 10 percent of total) and open storage.

(10) More than one depot may be established for an army but if it is possible to meet supply needs with one it is best to establish only one initially. Additional depots may be located farther forward or to rear as the situation changes.

(11) Personnel for operation of depots consists of depot companies, shop companies, and other engineer troops. For a very large establishment a separate battalion may be assigned. In this case personnel of depot companies may be attached to the separate battalion to furnish expert supply personnel.

(12) Requirements of a railhead are similar to those of a depot but much smaller. Siding capacity for one standard

train is usually sufficient and issue normally will be direct from railroad cars to trucks of the units drawing supplies, or with a minimum of preliminary sorting on the ground.

■ 229. **TYPICAL ARMY ENGINEER SUPPLY DEPOT.**—A typical layout for an army engineer supply depot in the combat zone is shown in figure 39. The areas required for the various classes of supplies are based on an estimated initial depot stockage of 15 days' supply for an army of three corps of three divisions each in a relatively stable situation. Operating force is one depot company. It may be used as a guide only. It must be modified as necessary to conform to existing terrain and communication facilities, type of operations to be expected and hence stockage to be maintained, and to many other and varied considerations always existing. It must be protected against aircraft, and establishments scattered and camouflaged to minimize effects of aircraft bombing.

■ 230. **DEPOTS IN COMMUNICATIONS ZONE.**—In the communications zone an engineer depot may be exclusively an engineer establishment in which case it is called a special depot, or it may be an engineer section of a general depot. In a general depot an officer is designated as engineer supply officer. He has charge of proper storage care, maintenance, and issue of all engineer supplies, equipment, and material under such instructions as may be prescribed by the engineer of the communications zone. He controls the necessary technical personnel to handle the engineer supplies and the records pertaining thereto. He supervises loading and unloading of engineer supplies, proper marking of all shipments, and transmittal of information in regard to shipments to consignees through prescribed channels. He arranges for transportation only through duly constituted transportation agencies which are under supervision of the commanding officer of the general depot.

■ 231. **SPECIAL SUPPLY DEPOT.**—*a. Organization.*—A large special engineer supply depot in the base or intermediate section of the communications zone consists of a headquarters, a supply department, and an operating department. A general outline of its organization, which must be flexible and capable of rapid expansion, is as follows:

(1) *Headquarters.*—(a) *Depot engineer officer.*—In command and is responsible for organization and operation of the depot.

(b) *Personnel officer.*—Looks after all administration, camp orders, travel orders, and correspondence.

(c) *Chief clerk.*—Looks after all paper work of the depot, and has three sections directly under him as follows:

1. *Requisition.*—Handles all incoming requisitions, gives them the depot requisition number, passes them to the supply department, and later checks shipments against the requisitions.

2. *Inventory.*—Receives inventories from sections of the supply department and consolidates them into a complete depot inventory. The consolidated inventory is sent periodically to the section engineer under whose control the depot operates.

3. *Mailing and filing.*—Handles all correspondence for the depot.

(2) *Supply department.*—Under one of the depot engineer officer's assistants, and is divided into sections as follows:

(a) *Mechanical.*—Handles power-operated equipment, cranes, boilers, engines, hoists, derricks, concrete mixers, gas engines, cables, etc.

(b) *Barracks and buildings.*—Handles wooden barracks, steel buildings, warehouses, hospital wards, corrugated iron, roofing paper, etc.

(c) *Water supply.*—Handles pipe, pipe fittings, pumps, well drillers, bath supplies, plumbing, well casing, and all special water supply material.

(d) *Forestry.*—Handles sawmills, sawmill supplies, special saws, axes, and other equipment required for lumbering operations.

(e) *Roads.*—Handles all road-making equipment, road graders, dump trucks, scrapers, plows, scarifiers, road rollers, and similar special equipment required for road construction.

(f) *General.*—Handles all general hardware, small tools, hammers, carpenter tools, blacksmith tools, and all tools common to several departments.

(g) *Pioneer.*—Handles unit equipment, technical supplies, special supplies for combat troops, etc.

(h) *Construction materials*.—Handles lumber, sand, gravel, stone, trench boards, A-frames, etc.

(i) *Electrical*.—Handles generators, motors, lamps, electric wire, insulators, switches, etc.

(j) *Railways*.—Handles rails, track gages, lanterns, flags, track tools, and all railway equipment used for maintenance of way and equipment.

(k) *Camouflage*.—Handles paints, paint brushes, paint-spraying machines, osnaburg (or burlap), chicken wire, smooth wire, cotton cloth, and all special camouflage materials.

(l) *Searchlight*.—Handles searchlights and special material pertaining to them.

(m) *Mining*.—Handles mining supplies except explosives and all special equipment for mining operations.

(n) *Explosives*.—Handles all explosives.

(3) *Operating department*.—Divided into sections as follows:

(a) *Crane and yard equipment*.—Has charge of all crane crews, cranes, yard equipment, etc. It works in conjunction with all sections that require service in loading and unloading cars.

(b) *Transportation and shipping*.—Looks after spotting of all cars and makes out bills of lading. This requires that men be suitably placed in receiving yards of depots to mark all cars for the engineer depot, giving track and yard location, and to assist train crews in spotting cars in the proper section and at the right place. The transportation and shipping section attends to ordering all empty cars for shipments and acts as the depot agent between all sections of the engineer depot and the railway service. It has charge of all convoys on convoyed shipments.

(c) *Small lots*.—Looks after all shipments less than car-load lots. These shipments are taken from the different supply sections to the small-lot shipping platforms, whence they are shipped by truck or local freight to destination.

(d) *Trucks and local transportation*.—Handles all truck transportation assigned to the depot, and makes local deliveries for the small-lot shipping section.

(e) *Salvage*.—Receives all salvaged material, reclassifies it, and turns over that portion in good condition to the proper issuing sections for reissue.

(f) *Labor*.—Has charge of all pool labor of the depot, and assigns it to the various sections according to the amount of work each has for the day. Through this section the depot engineer officer can control priorities.

b. *Typical operations*.—When the supply department receives requisitions from depot headquarters, it requests the necessary cars from the operating department. When cars have been loaded, it notifies the operating department, giving data for preparation of the bill of lading, and then reports to depot headquarters that the requisition has been filled. The headquarters checks the filled requisition with the original and notifies the consignee by wire and letter, giving car numbers, bill of lading number, and date of shipment. This permits the consignee to make plans for receipt of the goods and to initiate a tracer of the shipment if necessary.

■ 232. **ADVANCE SUPPLY DEPOTS**.—Engineer supply depots in the advance section of the communications zone are much smaller than those in the base or intermediate sections. They are located about 6 to 8 hours' freight haul from the railheads. They carry the more common engineer supplies and technical equipment for combat engineer troops. The supply sections are less numerous than in the organization given in paragraph 231, but they are organized on the same lines, two or more of the depot sections being combined into one at the advance depôts.

SECTION IV

MAP SUPPLY

■ 233. **FUNDAMENTALS**.—a. Adequate supply of the best and most suitable types of maps that can be made available is essential to efficient military operations.

b. Coordination of map-making and map supply agencies of the forces is essential to success and is a vital command function. Allowances of maps will be prescribed for each theater of operations by the commander thereof.

c. Where suitable maps for military purposes do not exist, the aerial photograph in its various forms must be accepted.

The aerial photograph will not only serve as a map but as a means of producing a map by photogrammetric methods. Where suitable maps are available, the aerial photograph will be used to supplement the information on the map.

d. Except for initial allowances of existing military maps, automatic supply will be impossible. Considerable bulk and weights are involved. The initial allowance of maps for a field army will weigh approximately 15 tons. Supply of maps and aerial photographs requires continuous coordination and supervision both as to procurement and distribution.

e. Decentralization of production, reproduction, and distribution will be necessary. Means must be provided in appropriate echelons for procuring photographs, making maps, and producing and distributing both in quantity.

■ 234. MILITARY MAPPING AND SUPPLY MISSION.—Owing to lack of suitable topographic maps of the United States as well as of other parts of the world, the army must be prepared to map as it moves in the theater of operations. The Corps of Engineers and the Air Corps are trained and equipped to provide the necessary maps in the field. This requires decentralization of map preparation and map supply.

■ 235. TYPES.—*a.* Maps used in the theater of operations consist of those prepared—

(1) During peace.

(2) After outbreak of hostilities.

b. Maps prepared during peace ordinarily will be of small scale, either planimetric (without relief) or with relief of a very general nature.

c. Maps prepared after outbreak of hostilities consist of those prepared initially by compiling information from existing source material and those produced by troops in the field.

d. Classification of military maps as to purpose, characteristics, use, types, how prepared, scales, etc., is covered in FM 30-20 and AR 300-15.

■ 236. RESPONSIBILITY FOR MAPPING AND MAP SUPPLY.—*a.* The Chief of Engineers under policies prescribed by the assistant chief of staff, G-2, is charged with all military mapping in the zone of the interior and with preparation or procurement

of such maps of foreign territory as may be prescribed by the Secretary of War. He is responsible for the supply of maps needed for training purposes by authorized organizations and individuals in the military service. He prepares the initial supply of maps that may be needed in an emergency.

b. The Corps of Engineers and the Air Corps are charged jointly with preparation of all maps requiring use of aerial photographs.

c. The Air Corps is charged with aerial photographic work for military mapping operations in accordance with specifications prepared by the Corps of Engineers.

d. The Corps of Engineers is charged with preparation of maps and map substitutes from aerial photographs, with prosecution of surveys, with compilations for production or revision of maps, and with their production, reproduction, supply, and distribution.

e. In a theater of operations coordination of map-making and supply agencies is a function of command.

(1) Unit engineers of the various echelons of command (GHQ, army, corps, and division) are responsible for preparation or procurement, production, reproduction, supply, and distribution under approved policies of the various commanders and under direct supervision of the various assistant chiefs of staff, G-2, of all maps required by their units for the operations.

(2) GHQ, army and corps topographic units, and the map section of divisional engineer units are under control of the respective unit engineers. Within limits and capabilities of his equipment and personnel to execute and in cooperation with the unit G-2, the unit engineer is charged with the following duties:

(a) Requisition of necessary maps obtainable from higher echelon.

(b) Preparation of maps not obtainable from higher echelon that are required for his unit.

(c) Liaison with the Air Corps for furnishing photographs for mapping purposes or map substitutes.

(d) Assignment of mapping missions with priorities in accordance with the tactical situation and policies of the unit commander.

(e) Reproduction of maps, sketches, overlays, graphical data, aerial photographs, etc., as necessary.

(f) Preparation of table of map allowances in cooperation with G-2 of the unit.

(g) Distribution of military maps, except such confidential or secret maps as may require special distribution.

(h) The cartographic (chart or map) representation of all information of the enemy obtained from all available sources.

■ 237. MAPPING AND MAP SUPPLY UNITS.—*a.* For detailed operations of the various mapping units, including types of maps produced and reproduced, see chapter 8.

b. For divisional engineers, see paragraphs 40 and 48.

■ 238. INITIAL ALLOWANCES OF EXISTING MAPS.—Initial allowances of existing military maps are as follows (see FM 30-20 and AR 300-15):

a. Small scale maps from 1:1,000,000 to 1:7,000,000 for general planning and for strategical studies:

(1) *Regular.*—One copy per headquarters component shown in Tables of Organization of each organization considered down to and including the battalion or similar unit.

(2) *Exception.*—Organizations covered by special allowances.

b. Intermediate scale maps normally from 1:200,000 to 1:500,000 for planning operations, including movements, concentration, and supply of troops.

(1) *Regular.*—(*a.*) One copy per commissioned officer of each headquarters shown in Tables of Organization down to and including the battalion or similar unit.

(*b.*) One copy per organization assigned a Table of Organization down to and including the battalion or similar unit.

(*c.*) One copy per section of division, brigade, regimental, and battalion staffs.

(2) *Exceptions.*—(*a.*) For cavalry, the allowance will be increased by 50 percent.

(*b.*) For the Air Corps, aeronautical charts will be issued in lieu of intermediate scale maps.

c. The allowance of aeronautical charts for the Air Corps is—

GHQ Air Force, 25.

Division headquarters (air section), 100.

Each wing headquarters, 10

Each group headquarters, 10.

Each squadron headquarters, 4.

Per airplane, 4.

d. Medium scale and large scale maps normally from 1:125,000 to 1:20,000 for strategical, tactical, and administrative studies, and for tactical and technical battle needs.

(1) *Regular*.—(a) One copy per commissioned officer.

(b) One copy per each component shown in Tables of Organization of each organization considered as follows:

3 copies per component regiment or larger unit.

2 copies per component battalion.

1 copy per component company.

(c) One copy per section of division, brigade, regimental, and battalion staffs.

(2) *Exceptions*.—(a) The Air Corps will be allowed 10 copies of the medium scale map per observation airplane. No copies of the large scale map will normally be issued to the Air Corps.

(b) 100 to division staff.

NOTE.—Division headquarters (or, in the case of smaller expeditions acting independently, the headquarters thereof) normally will be allowed an additional quantity of each map equal to 50 percent of the initial distribution provided above, normally to be in custody of the division or detachment engineer, to be issued as required prior to the reproduction of maps in the field.

■ 239. ALLOWANCES OF MAPS PRODUCED IN THE FIELD.—The allowances of maps produced in the field in time of war will be prescribed for each theater of operations by the commander thereof.

■ 240. MAP SUPPLY AND DISTRIBUTION.—a. Maps are class IV supplies and are furnished on requisition in the same manner as other engineer class IV supplies.

b. Each unit engineer is charged with the distribution of maps under the policies and supervision of the unit G-2, except such confidential or secret maps as may require special distribution. He will obtain maps not published by his unit from the engineer of the next higher unit.

c. Table II below shows channels for map supply and distribution.

TABLE II.—Map supply and distribution

Organization or unit	Agency responsible for policies	Agency responsible for drawing and issuing	Agency from which secured	Remarks
GHQ and GHQ troops.	G-2, GHQ.	Chief engineer GHQ ¹ .	War Department GHQ topographical battalion ² and Base Plants. ³	G-2 supplies the headquarters.
Army.	G-2, Army.	Army engineer ² .	Army topographical battalion ² and engineer GHQ. ³	Do.
Corps.	G-2, corps.	Corps engineer ² .	Corps topographical company ² and Army engineer. ³	Do.
Division.	G-2, division.	Division engineer ² .	Corps engineer ² .	Do.
Regiment.	Regimental S-2.	Regimental S-2.	Division engineer ² .	
Battalion ¹ .	Battalion S-2.	Battalion S-2.	Regimental S-2.	
Company ¹ .	Company commander.	Company commander.	Battalion S-2.	

¹ Applies similarly to squadrons.² Applies similarly to troops or batteries.³ Only these agencies are authorized to maintain stocks of maps

■ 241. DISPOSITION WHEN TROOPS LEAVE AREA.—Whenever a tactical organization is relieved from duty in a particular area, the commanding officer thereof is responsible that all maps and map substitutes are collected and turned over to the commanding officer of the relieving unit or, if not replaced by troops, to the engineer of the territorial command who will cause all unserviceable copies to be destroyed under the personal supervision of an officer. Particular care will be taken to insure that no maps or map substitutes are abandoned.

CHAPTER 12

TRAFFIC CIRCULATION

	Paragraphs
SECTION I. Control.....	242-247
II. Considerations affecting plans.....	248-253
III. Formulation of plans.....	254-257

SECTION I

CONTROL

■ 242. REGULATION.—*a.* The heavy and continuous traffic to which roads in a combat zone are subjected requires complete and thorough regulation of traffic. To insure efficiency in supply, evacuation, and troop movements traffic must be regulated in accordance with a plan based on the tactical situation and a thorough study of capacity and condition of available roads. The fewer the roads and the poorer their condition, the greater the necessity for a carefully planned system of traffic circulation and control. Elimination of animal-drawn transportation for supply and evacuation removes the difficulties incident to its coordination with motor transportation. However, complications are introduced through need for good roads for motors somewhat further to the front than heretofore. Traffic management, with particular reference to motor transport, is covered in FM 25-10.

b. Principal measures for regulation of traffic are—

(1) Formulation and issuance in orders of the traffic circulation plan embracing—

(*a*) Reservation for necessary time of separate roads for tactical movement of troops. When such reservation of separate roads for different types is impracticable due to lack of sufficient roads, different types of traffic may be allotted use of the same road on a time schedule.

(*b*) Provision of circuits of one-way roads, including two-track roads used for one-way operation where such use is advantageous.

(*c*) Reduction to the minimum of crossing of traffic currents.

(2) Erection and maintenance of legible and readily understood traffic signs to indicate authorized directions of movement and locations of units and establishments.

(3) Provision of an ample supply of traffic circulation maps.

(4) Rigid enforcement of traffic regulations and march discipline by all commanders.

(5) Organization and subdivision of the road net for purposes of construction and maintenance.

(6) Establishment of necessary traffic control posts and traffic patrols for enforcement of traffic regulations and for guidance of movements on roads.

■ 243. PRIORITY.—*a.* Priority of traffic toward the front during active operations will depend upon the tactical situation. It is essential that priority lists be furnished traffic control personnel who must otherwise use their judgment in case of congestion by clearing a traffic jam in the most expeditious manner.

b. In case of attack a line, usually a road generally paralleling the front, is designated as a barrier line beyond which vehicles will not be permitted to proceed except as provided for in the priority list of the circulation plan. This line is designated to limit circulation in the forward area until the attack is well launched in order to afford combat units and their accompanying transportation full freedom of maneuver. The following may be taken as a rough guide governing priority in passing the barrier line:

Priority	Class of vehicle
1.....	Ambulances, staff cars, motorcycles.
2.....	Signal Corps trucks.
3.....	Trucks loaded with road or bridge material.
4.....	Trains of regiments and lower units, not accompanying troops.
5.....	Trucks loaded with ammunition or with gasoline for tanks.
6.....	Trains of the divisional service units.

■ 244. JAMS.—Traffic jams can be avoided by proper planning (see par. 242). They are usually due to the following causes:

a. Faulty traffic circulation plans.

- b.* Unnecessary directions, complicating the system.
- c.* Errors in timing and routing of columns.
- d.* Poor traffic control, especially at road intersections and supply points.
- e.* One-track bridges or other defiles on two-track roads.
- f.* Poor march discipline of troops and transport.
- g.* Motor traffic routed on roads which will not support it.

■ 245. **CENTRALIZED CONTROL.**—*a. General.*—The necessity for adapting the supply and evacuation system to changes in the situation at the front and for coordinating transportation by road and by railroad requires centralized control of traffic. In the combat zone such control is primarily a function of army commanders. Each subordinate commander (corps and divisions) so organizes and regulates traffic under his jurisdiction as to conform to the system prescribed by his immediate superior.

b. Army control.—The army, either by means of a circulation map or by paragraphs in the army administrative order, provides for circulation within the army area and for restriction within indicated limits of use of certain specified roads. These restrictions for important roads may extend into corps and possibly division areas. The corps, however, is normally responsible for all circulation within its own area. Only in case of need for adjustment of conflicts between two corps circulation plans or because of army requirements will the army specify traffic circulation extending into the corps area.

c. Corps control.—The corps may prescribe circulation on the main roads in divisional areas in order to coordinate the division traffic control plans with its own. This is often necessary in an attack when the road net does not provide within the zone of each division at least one forward-bound and one rear-bound road. The divisions must obtain approval of the corps before making any changes in their own circulation plans which will affect the corps plan.

d. Division control.—Subject to such restrictions as are imposed by higher authority, the division prescribes the circulation within its own area. No division plan should provide for use of any road outside the division area unless authority therefor has been given in the circulation plan of the corps

or has been obtained by arrangement with the unit concerned or with the corps.

■ 246. DUTIES AND RESPONSIBILITIES OF SUBORDINATES.—*a.* Formulation of a plan of road circulation and traffic control within a unit is a function of the G-4 section of the staff of that unit, cooperating with the G-3 section in regard to the tactical plan. Issuance of orders for road circulation and traffic control is a function of the commander. These orders are promulgated as part of the administrative order. A circulation map usually is issued as an annex thereto. Enforcement of the orders is the duty of military police operating under direction of the provost marshal.

b. The circulation plan prepared by G-4 ordinarily is based on recommendations of the unit engineer. The latter is responsible for reconnaissance of routes and for submission of recommendations to G-4 as to direction, amount, and kind of traffic to be authorized on the various roads. The unit engineer is also responsible for construction, repair, and maintenance of roads and bridges, for regulation of traffic over bridges, for preparation and posting of signs to mark routes and direct traffic, assistance of traffic over particularly bad sections of roads, and, when ordered in an emergency, for relief of traffic jams.

c. In a critical situation or where engineer work is of paramount importance, the unit engineer may be made temporarily responsible for enforcement of traffic circulation and control orders. He should, in this case, be given assistance of military police and such other assistance as he may need.

■ 247. CONTROL SYSTEMS.—*a. Escort.*—The escort system is employed for movement of small bodies of troops or of columns not in presence of the enemy and on roads not in constant use. Motor traffic control groups proceed in advance along the routes to be followed. They notify such control agencies as exist to block off all traffic until troops or columns have passed. At crossings, supply points, and other places where there are no control posts they take station far enough ahead to insure the march being made without interference by other traffic. When the head of the column reaches a post thus established, the escort proceeds to the next unposted point,

clearing the road as it goes. This procedure is carried out until the troops have reached their destination. If there is an extended interval between troops and transport, separate blocking parties should be detailed for each. This system presupposes priority on the road to the column using it.

b. Point.—(1) The point system of traffic control consists of use of traffic control posts and patrols. It is employed—

(a) On roads in constant use.

(b) During movements of large bodies of troops on roads not in constant use.

(2) Duties of traffic control posts of the point system are to—

(a) Require all traffic to follow route prescribed in traffic orders and as indicated by traffic signs.

(b) Control and regulate passage of all vehicles and prevent blocking of roads. At points where congestion is likely to occur, vehicles must be kept moving.

(c) Stop all vehicles proceeding against authorized traffic direction except those having special authority for such action. If not authorized to proceed against traffic, make and number of any such vehicle, together with army serial number and organization of the driver, will be taken and if feasible the vehicle will be turned back and ordered to proceed to its destination by the authorized route.

(d) Stop all vehicles exceeding prescribed speed limit and to report the drivers except where there is a manifest emergency.

(e) Enforce compliance with all traffic regulations.

(3) Each traffic control post is furnished—

(a) A copy of the circulation map.

(b) A copy of any special traffic control orders.

(c) Signboards showing directions, distances, etc.

(d) Red and white lanterns where lights are allowed.

(e) Priority list.

(f) March tables or march graphs covering movements of large units.

(4) Traffic patrols of the point system consist of men mounted on motorcycles who singly or in groups of two or more constantly patrol the roads between traffic control posts. They are charged with the same general duties as traffic

control posts. They also make daily reports on condition of roads, including location and extent of landslides, shell holes, bad ruts, accumulation of water in depressions, spongy or soft spots in metalled roads, and any other evidences of deterioration. Patrols should be furnished the same kinds and means of information as traffic control posts.

c. *Schedule*.—(1) The schedule system, which is an elaboration of the escort system, is essentially an adaptation from railroad practice. It is particularly applicable to static situations with large volumes of traffic. It is also useful in rear areas where railroads are inadequate or nonexistent. Its greatest usefulness is on a single road without crossings, although cross traffic can be taken into account without great difficulty. This method of dispatching may be used in conjunction with either the escort or point system for detailed control.

(2) To use this system, crossing roads and side streets in towns must be available for use as make-up and dispatching yards for motor trains. Turn-outs must be provided for vehicles in local service such as road material carriers, and for disabled vehicles. All traffic usually will move at the same average speed; if it does not, facilities analogous to sidings to permit overtaking and passing must exist. Control posts are located at all intersections of any importance, and may be at intermediate intersections if distances are great. Facilities for communication between these stations by wire, radio, motorcycle messenger, or by visual means are essential. Signals for traffic control such as traffic lights or semaphores are advantageous.

SECTION II

CONSIDERATIONS AFFECTING PLANS

■ 248. *GENERAL*.—Traffic circulation means movement of traffic over roads in accordance with a plan which prescribes direction of movement and class of traffic allowed over various roads. While considerations affecting traffic circulation plans are many and varied, the principal ones are—

- a. Tactical situation.
- b. Roads and road net.
- c. Transportation available.

- d. Supply and evacuation plan.
- e. Restrictions by higher authority.

■ 249. TACTICAL SITUATION.—All traffic circulation plans must conform to the fundamental that requirements of combat troops must be given primary consideration. In formulating a traffic circulation plan all troop movements, known or foreseen, by any and all means (motor, foot, animal) should be allotted such roads and periods of use as will insure their arrival at their destination at the proper time and with the least possible delay and fatigue. After a traffic circulation plan has been formulated and put into effect, troop movements cannot always be planned so as to conform to this plan but will in the main be determined by action of the enemy or other circumstances, time and distance being normally the controlling elements. Tactical necessity may demand utilization of roads for troop movements without regard to the circulation enforced for supply and evacuation or other purposes. Control of traffic under the circulation plan in force and the plan itself must be sufficiently flexible so that prompt adjustment to meet changed conditions necessitated by troop movements may be made without delay or confusion.

■ 250. ROADS AND ROAD NET.—*a. Importance.*—The rate of movement of an army is limited to a great extent by the rate at which it receives supplies. In warfare all supplies must eventually reach the troops by road. The road system should be adequate to carry all supplies from the railroad terminals to troops in advance of these points, to supplement the rail system by relieving it of part of its load, and to replace it entirely during temporary breakdowns. In recent years there has been a marked increase in the volume of road traffic due to organization in depth over broad fronts, development of motor transportation and armored forces, and great increase in requirements of ammunition and engineer supplies and in daily march and rate of advance. Thus an adequate net of good roads is necessary to the modern army.

b. Types.—All roads fall under two general headings, namely, standard and improvised or hasty (see FM 5-10).

(1) Standard roads are all roads designed and constructed in general accordance with civil practice. They may be classi-

fied as high type and low type. High-type roads, that is, hard-surfaced pavements of blocks, cement concrete, bituminous concrete, or any of the various types of macadam pavements, are capable of bearing sustained traffic in all kinds of weather, and are termed "all-weather" roads. However, the water-bound macadam road requires heavy maintenance in wet weather and under heavy motor traffic. Low-type roads, that is, gravel, coral, shell, sand-clay, or earth roads, are all difficult to maintain for heavy traffic or in wet weather, under which conditions they deteriorate rapidly. If well-drained, sand-clay and earth roads will bear a moderate amount of traffic in dry weather. In wet weather they will bear no heavy motor traffic and animal-drawn traffic will move with difficulty.

(2) *Improvised or hasty roads* are all roads of a cruder type than the standard roads, used to move traffic across otherwise impassable areas. Included are plank, corduroy, wire mesh, and tread roads and trails. They are usually constructed to meet exigencies of a particular situation.

c. Classification.—(1) *One-track.*—A one-track road is one which is capable of accommodating only one column of traffic. It requires a minimum width of 9 feet, and preferably 10 feet. In civil practice the term "lane" is used instead of "track."

(2) *Two-track.*—A two-track road is one which is capable of accommodating two columns of traffic, either in the same or in opposite directions. It requires a minimum width of 18 feet. A four-lane highway will provide a two-track (two-lane) road in each direction.

(3) *One-way road.*—A one-way road is one on which traffic moves in one direction only. It may be either a one-track road or have two or more tracks.

(4) *Two-way.*—A two-way road is one on which traffic moves in both directions. In designating two-way roads consideration must be given to widths of roadway, culverts, and bridges, since one-track stretches form bottlenecks which materially reduce capacity of two-way roads.

d. Traffic capacity.—(1) Traffic capacity of a road depends primarily on tactical considerations governing its use and on its type, quality, condition, and type and regulation of its

traffic. Engineer reconnaissance is necessary in order to determine type and amount of traffic that can be routed over a particular road.

(2) In a continuous motor column the number of vehicles which will pass a given point in a given period of time is dependent upon speed and average distance between vehicles. As the speed increases the safe driving distance between vehicles increases; at speeds of from 10 to 35 miles per hour the safe driving distance varies almost directly with the speed. Observations of civilian traffic indicate maximum traffic capacity at about 33 miles per hour but for practical purposes traffic capacity at all speeds between 25 and 45 miles per hour is constant.

(3) Where tactical considerations permit, and consistent with prescribed speed of traffic, motor columns will utilize traffic capacity of the road to the utmost if leading vehicles move at a constant speed and following vehicles maintain minimum safe driving distance. The minimum safe driving distance is not fixed but is determined by each driver as a result of training and experience. A column of 100 1½-ton military trucks will, when moving at a speed of between 10 and 35 miles per hour, normally have a time length of about 8 minutes. Therefore, normal traffic capacity of a single road lane supporting a continuous column of motor trucks moving at a constant speed within this range is about $\frac{60}{8} \times 100$, or 750 vehicles per hour. Although traffic capacity of a road is greatly affected by road conditions, visibility, passing or crossing traffic, terrain, and similar factors, this figure of 750 vehicles per lane per hour may be used in computing normal traffic capacity of a road for military trucks.

(4) For short periods of time only, in order to prevent capacity of an entire road system from being reduced by towns where different lines of traffic merge or by other bottlenecks in the system, the distances between vehicles may be decreased if careful traffic regulation is observed. For speeds of from 25 to 35 miles per hour this reduced distance may be taken as slightly more than one-third of the normal driving distance. Thus the ultimate capacity of a single lane of traffic through towns or other bottlenecks at 25 to 35 miles per hour may be taken roughly as about 2,000 vehicles

per hour. If the speed falls below 25 miles per hour the ultimate capacity decreases rapidly. At 15 miles per hour, about the maximum practicable speed for hours of darkness, 1,200 vehicles per hour at an average distance center to center of about 22 yards is the ultimate capacity. Converting the above figures to tons carried by $1\frac{1}{2}$ -ton trucks, in 14 hours of daylight and 10 hours of darkness, the ultimate capacity of a single lane of traffic through towns or other bottlenecks is about 60,000 tons; the normal capacity on the open road is about 27,000 tons. During 10 hours of darkness, the ultimate capacity is about 18,000 tons and the normal capacity is about 11,000 tons. The above figures are based upon a single lane of traffic without opposing traffic in the adjacent lane, all vehicles moving at the same speed on an unobstructed road. Obviously, presence of slower-moving vehicles in the column, loss of time due to breakdowns, and impracticability of maintaining continuous traffic at a constant speed will result in reducing these figures. The advantage of using roads of more than one track for one-way traffic to reduce such difficulties and to eliminate delays incident to left turns across opposing traffic is obvious.

(5) As previously shown, where a road bears a continuous stream of traffic and where the problem is only one of moving the maximum tonnage daily over the road, there is no advantage in excessive operating speeds. The speed giving the maximum capacity and at the same time the safest and most economical operation (about 30 m.p.h.) is the proper one. However, where the problem is to complete a given movement of troops or supplies in the least possible time, the proper average speed is about 35 miles per hour in convoy. Speeds greater than this are not justified due to excessive distances between vehicles, danger of accidents, difficulty of control, and, in the case of heavy vehicles, excessive damage to the road.

■ 251. TRANSPORTATION.—Tables of Organization for the units comprising the infantry divisions eliminate all animal-drawn supply and evacuation transportation. Under these tables, the only animals are in the horse-drawn field artillery regiment of the square type division. All trains are fully motorized, including trains of the horse-drawn artillery regi-

ment. It follows therefore that good motor roads must be available or made available for all supply and evacuation purposes; and in almost every situation they will be necessary for movement of combat troops and equipment, either by their organic motor transportation or by motor transportation temporarily assigned for the purpose.

■ 252. SUPPLY AND EVACUATION.—*a. General.*—The subject of supply and evacuation, including the general supply principles, classification of supplies, nature and locations of supply and evacuation establishments, and classification and operations of trains, all of which are essential to formulation of a traffic circulation plan, is covered in FM 100-10 and 100-15.

b. Location and establishments.—Locations of the supply, evacuation, and administrative establishments of the division must be known before the traffic circulation plan for the division can be completed. These establishments may include—

(1) Railhead.

(2) Supply point for gasoline and oil (normally at all depots, railheads, and truckheads or at convenient locations on main supply routes leading thereto).

(3) Ammunition supply point (may be an army ammunition railhead, truckhead, or depot).

(4) Engineer supply point (normally is the same as the railhead except in defensive situations when an army engineer railhead, truckhead, or depot is the supply point).

(5) Distributing points.

(6) Collecting stations for men.

(7) Ambulance stations.

(8) Clearing station or stations.

(9) Bivouacs of various regimental and lower unit trains.

(10) Bivouacs of various divisional service units.

(11) Command posts of division and next lower echelons.

(12) Rear echelon of division headquarters.

■ 253. RESTRICTIONS BY HIGHER AUTHORITY.—Restrictions on traffic by each echelon of command should be held to the minimum necessary. These restrictions may take several forms such as designation of a line beyond which vehicle lights are prohibited, designation of a line forward of which certain

classes of traffic may not proceed during daylight, designation of certain roads or of all roads in a prescribed area for exclusive use of a particular unit either for a specified time, or without limitation as to time. The restrictions imposed by higher authority may have an important influence on the traffic circulation plan of a subordinate unit such as a division, and must be rigidly adhered to in the formulation of a traffic circulation plan.

SECTION III

FORMULATION OF PLANS

■ 254. **GENERAL.**—*a. General.*—The fundamentals of traffic circulation are applicable to any tactical situation, although the amount of detail prescribed will vary widely in accordance with the situation. In a rapid advance where the road net is excellent it may be sufficient to prescribe merely the main supply road of the unit. In a stabilized situation where traffic is heavy and roads poor, the circulation plan may embrace the most minute details. In any case the plan must be flexible.

b. Reconnaissance.—Engineer reconnaissance must be performed wherever possible prior to formulation of a traffic circulation plan, since obstruction of routes by a retreating enemy or faulty map information may make the proposed plan impracticable.

c. Simplicity.—Any restrictions on traffic other than those absolutely necessary will impede rather than facilitate traffic circulation. The simplest plan which will provide for necessary supply and evacuation movements is the most efficient.

d. Road nets.—(1) When possible, a division should have at least two good roads within its area, one for traffic moving toward the front, the other for traffic returning to the rear, thus providing a one-way road circuit. In planning such a circuit, consideration should be given to condition of the road, and when feasible the best road should be designated as the forward route, as practically all transportation moving to the front is loaded while that returning to the rear is generally empty. This road will be designated as the main supply road and engineers will give it priority of maintenance.

In some situations but one good road leading into the divisional area will be available. If this is a two-track road, rearward-bound traffic may return by it. The main objection to a two-way road is that forward-bound traffic moving to the side roads leading to the left of the main supply road must cross rearward-bound traffic, and that rearward-bound traffic moving on to the main supply road from side roads on the right must cross forward-bound traffic. When this occurs careful traffic control is necessary. When practicable, directions for traffic leaving a two-way road should provide for right-hand turns. If there is only one good one-track road leading into the area the problem presents greater difficulty, as it will be necessary to route return traffic on the side roads to the right or left of the main road.

(2) Train bivouacs, supply points, clearing stations, and similar establishments should be located on loops or spurs off the main road. The best form of road is a loop providing for traffic exclusively forward on one road and back on another. On such a road the traffic is to a certain extent self-regulating, and a continuous stream of vehicles may be most nearly approached. Use of loop roads results in such a marked reduction in traffic congestion that they should be provided wherever practicable even if it is necessary to require two divisions to use the same loop.

(3) Traffic circulation should never be prescribed farther to the front than required by actual needs of traffic. Thus, traffic directions on routes forward of collecting stations for men will rarely be prescribed since heavy and continuous traffic is not to be expected forward of these points. A traffic circulation plan is intended primarily to regulate movement of trains performing supply and evacuation functions and is based on locations of the fighting front and supply and evacuation establishments.

(4) The traffic circulation plan should provide for use of existing standard roads to the fullest extent. Engineers must not be burdened with excessive new road construction or extensive improvement. Their most important duty is to maintain existing roads.

e. Defense.—When a position is to be organized and defended, a traffic circulation plan will be put in effect. Tenta-

tive circulation plans based on passing to the offensive or withdrawing from the position must be prepared and kept ready to be placed in effect for either of these contingencies.

f. Attack.—Prior to an attack road circulation will be prescribed but supply traffic will be reduced to a minimum in order to give combat troops access to the roads. The road net in the enemy's area is studied, and a tentative plan for circulation thereon is prepared. When it becomes necessary to move supply and evacuation establishments forward, this plan, revised as the result of engineer reconnaissance, will be put into effect as required by the situation. If the attack makes but little progress, evacuation and supply can function on their former basis, and the road circulation will remain unchanged. In an attack after a period of stabilization, the most critical part of the road system is that which extends across "no man's land." Here the roads will be few, in very bad condition, and will require the greatest attention.

g. Withdrawal.—In a withdrawal, movements of troops and supplies normally will be from the front to the rear. Movements in the opposite direction must be avoided as much as possible. Supplies should be evacuated first to clear roads for movement of troops. Routes or zones of withdrawal should be assigned for troop movements to the rear. Full advantage should be taken of two-track roads leading to the rear by using them as one-way roads. This will then permit movement of two columns of traffic abreast in the same direction, commonly known as "double-banking." As withdrawals usually take place under cover of darkness, control of traffic is of primary importance. Any traffic jams which occur increase the danger of capture by the enemy of the delayed transportation.

■ 255. PREPARATION OF PLAN.—Knowing the locations of supply, evacuation, and administrative establishments and fundamentals of supply, evacuation, and traffic control, formulation of the traffic circulation plan and preparation of the circulation map is undertaken.

a. Tactical situation.—The initial consideration is the tactical situation, including necessary troop movements and restrictions by higher authority. Thus in an attack or defense of a position, troops and supplies must move to the

front while the sick, wounded, and prisoners move to the rear. Situations will sometimes arise, as in delaying actions, where certain types of supplies move to the rear, while other types such as ammunition are being moved to the front.

b. Road net.—(1) A careful study should next be made of the existing road net, and a tentative decision reached as to direction of traffic to be prescribed for roads leading to the front and returning through the area. The results of all available road reconnaissance should be noted and considered, since condition of the roads and bridges is of primary importance. As previously stated, the best route will usually be selected as the route to carry the greatest volume of supplies. Care must be taken that routes for movements from the front are provided; that evacuation to the clearing station is made as direct as practicable; that movement of loaded vehicles to unit train bivouacs, ammunition dumps, and engineer distributing points, and their return to the rear after unloading is made as direct as practicable; and that back hauls for loaded vehicles are reduced to a minimum.

(2) With direction of traffic determined for main routes of travel to front and rear, the next step is to decide upon direction of traffic on lateral roads.

c. Tests.—The last step is to test the circulation plan with respect to functioning of trains as given in FM 100-10. In addition it should be tested with respect to—

(1) Movements of regimental and lower unit trains to water supply points and engineer distributing points, thence to points of delivery, and thence to bivouac.

(2) Movements of supply vehicles of the signal and ordnance units to their respective supply points, thence to their bivouacs.

(3) Engineer vehicles must have access to all parts of the area for work without having to use very circuitous routes.

d. Roads crossing boundaries of area.—Having completed the tentative circulation plan for roads lying wholly within the area of the division it is then necessary to indicate traffic directions on sections of roads crossing the division boundaries. Agreement should be reached with adjacent divisions with regard to traffic directions, provided the corps has not already prescribed these details.

e. Circulation map.—A circulation map is normally issued by the division as an annex to the administrative order in the form of an overlay to a map referred to therein. On this overlay are shown the road net, the prescribed circulation on the roads, and the locations of supply, evacuation, and administrative establishments. This information may be readily transferred from the overlay to the basic map of the receiving unit, or the overlay itself may be used for the direction of traffic. Sufficient information to permit such use should be included on the overlay.

■ 256. EXAMPLES.—*a.* There is but one good one-track road, A—B, leading to the front near the left boundary of an area, and a return route near the right boundary, as shown in figure 40①. The road A—B is the route over which all in-going, that is, forward-bound, traffic should move, and hence is designated as the main supply road. Vehicles returning to the rear will take the road C—D. The roads B—C, a—b, c—d, and e—f are lateral roads. The direction of traffic on these roads is alternated as indicated by the arrows. Under this arrangement loaded vehicles, in order to reach supply points located along the road a—b, for example, must follow the circuitous route: A—B—C—b—a—B—C—D. Note the back haul necessary to serve an establishment located along b—d. Traffic over all the lateral roads moves from left to right. Establishments located on the road a—b may be reached by following the route A—a—b—D. Similarly, the problem is simplified for all locations. Note that in order to reach establishments located on the road C—D some back haul of supplies toward the rear is necessary. In this case, however, supplies dumped at d, for example, cannot be moved forward, whereas in the first instance they can reach the main supply road via the route d—f—e.

b. There is one good one-track road leading to the front located approximately in the center of an area, and two roads, one on the right and one on the left, available for return traffic as shown in figure 40 ②. The road A—B is the main supply road, return routes are indicated as C—D and C'—D', and the direction of traffic on the lateral roads is alternated on each side. No difficulty will be encountered in delivering

supplies to establishments located on the roads B—C' and c—d, nor will there be any difficulty in supplying establishments located on the corresponding roads B—C' and c—d'. Supplying the remaining four roads, b—a, f—e, b'—a, f'—e, will be less efficient due to the necessity for back hauls and circuitous routes. These back hauls are unavoidable under the assumption that the roads involved are one-track routes with the directions of traffic as shown.

c. Figure 40 ③ shows the same road net as in figure 40 ② with the direction of traffic on all of the lateral roads routed away from the main supply road A—B. With the return routes C—D and C'—D' provided, it is feasible to supply all establishments with a minimum of lost motion. However, as before, supplies dumped at any point on the lateral or return roads cannot be moved forward.

d. Another traffic arrangement is shown in figure 40 ④, under the assumption that the main supply road A—B is a two-track road. In this case a complete loop around each area between lateral roads is provided by utilizing the main supply road A—B as a two-way road so that it carries all forward-bound as well as all rearward-bound traffic. The fault in this system lies in its complexity. Traffic control will be difficult and without an undue use of control personnel traffic jams will occur. In addition, there will be many left-hand turns against traffic which might be avoided. A better solution in this case is to route traffic as shown in figure 40 ⑤, using A—B as a one-way, two-track, forward road. The routing is similar to that shown in figure 40 ③ except that the traffic on the roads e—f and e—f' has been routed toward the road A—B so as to facilitate forward displacement of supplies.

■ 257. SUMMARY.—From the foregoing, the following general rules relative to traffic circulation and control may be stated:

a. Engineer reconnaissance must precede formulation of a traffic circulation plan.

b. Formulation of the traffic circulation plan is a function of the G-4 section of the staff of the unit, and the plan is based on recommendations of the unit engineer.

c. Requirements of combat troops must be given primary consideration.

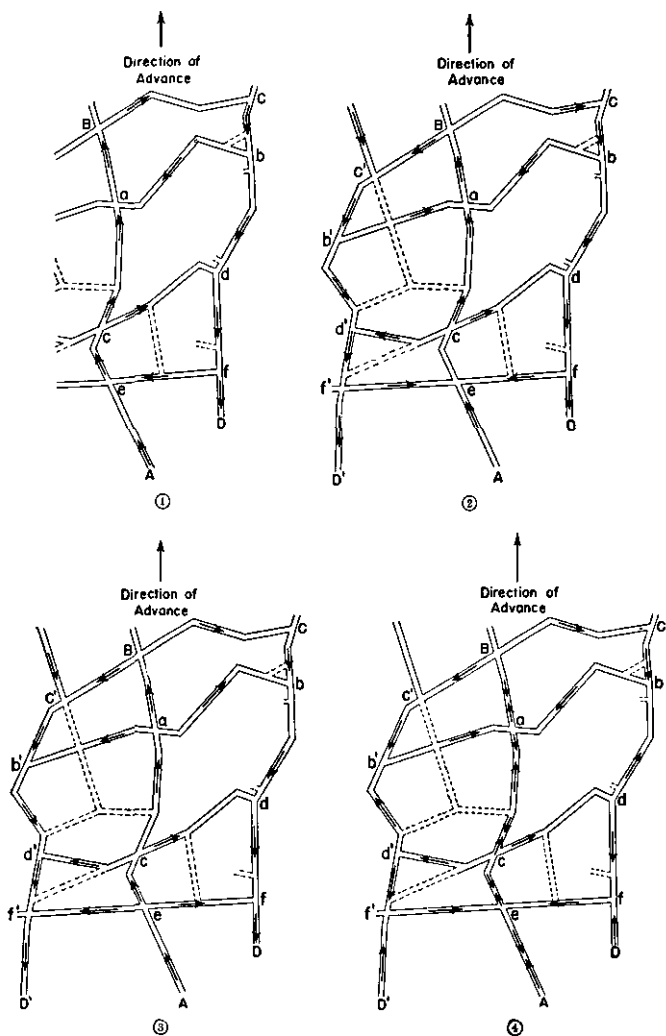


FIGURE 40.—Traffic circulation diagram.

d. Any plan of traffic control must be flexible to meet various contingencies.

e. Substantial road net is essential.

f. Traffic restrictions should be held to the minimum.

g. Traffic circulation is regulated with reference to location of the fighting front and of supply, evacuation, and administrative establishments.

h. Separate roads for troop movements by various means (motor, foot, animal) should be allotted for the purpose, and for the necessary periods of use.

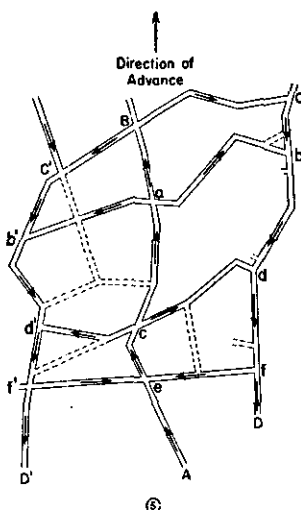


FIGURE 40.—Traffic circulation diagram—Continued.

i. Circuits of one-way roads to serve the various supply, evacuation, and administrative establishments should be provided.

j. Cross currents of traffic should be avoided as far as practicable, including left turns against traffic.

k. Clear and legible signs indicating prescribed directions of traffic and locations of establishments should be provided.

l. Circulation maps should be furnished to all agencies that require them.

m. Rigid and impartial enforcement by all commanders of traffic control regulations and of march discipline is essential.

n. Provision should be made for necessary construction and maintenance work on roads by engineers.

o. An adequate number of traffic control posts should be established with proper communication facilities.

p. Tentative plans should be prepared and revised as necessary to meet all possible changes in the tactical situation.

CHAPTER 13

OPERATIONS AND TECHNIQUE

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SECTION I

MILITARY OPERATIONS, EXCEPT RIVER CROSSINGS

■ 258. GENERAL.—Engineer missions and duties, especially those in the division, corps, and army are covered in general by paragraphs 1 and 2, and specifically for division engineers by paragraphs 49 to 55, inclusive. More general discussion is given in FM 100-5. This section summarizes methods of employment and duties of engineers in military operations. Owing to importance of river crossing technique and special equipment involved, river crossing operations are covered in section II.

■ 259. EMPLOYMENT.—a. (1) Engineer units must not be regarded as pools of laborers and mechanics to be allotted individually to various operations. An engineer organization is made up of a number of working units, each capable of executing a definite type and amount of work when commanded by experienced supervisors. It is so organized that it may be placed on a task rapidly and efficiently and so that it may be systematically combined with other units into larger groups for ease of control and supply. In combat battalions and regiments, general service regiments, aviation regiments, and separate battalions, this basic unit is the operating section of the platoon.

(2) Company, battalion, and regimental organizations are agencies provided to coordinate, supervise, and inspect the work of groups of these working units, to care for supply and administration, and to furnish men and equipment for tasks beyond the capacity of normal means assigned to the platoon

unit. The function of engineer supply is centered in the headquarters and service company, but the equipment of platoons and line companies is such as to assist in engineer supply if necessary. The above-mentioned organization for engineer tasks should be recognized by commanders of all units in making decisions as to employment of engineer troops.

b. Commanders of combat battalions or regiments usually apportion work to major subordinate units and direct use of their own headquarters in assisting operations of lower units by furnishing transportation, supplies, special equipment, and expert technical personnel. The unit commander and his staff officers make frequent visits to the various parts of the work, see that it is energetically prosecuted, and take corrective measures when necessary to promote the task.

c. Battalion commanders in regiments may be made responsible for assignment of their companies and attached units to parts or phases of the work and the exercise of functions of command and inspection. They arrange with higher headquarters for supply of engineer material, for protection of company equipment not taken on special missions and for attachment of extra personnel and vehicles when needed for particular tasks.

d. Company commanders usually divide their work into platoon tasks. The company headquarters attends to details of keeping platoons supplied with materials, and in supervising and inspecting the work.

e. If two or more engineer units are combined for work on a single task, as where a separate battalion is attached to a combat or general service regiment, tactical disposition of attached troops should preserve the chain of command within the attached organization. A portion of any attached unit should always be left under its own commander for work.

■ 260. IMPORTANT CONSIDERATIONS.—a. Practicability of engineer operations is determined by the factors of men, time, equipment, and materials. The time factor usually governs, although warning orders may reduce its importance. Ability to find and use local sources of materials may be of vital importance. If technical considerations have a real bear-

ing upon operations, they should be stated to the commander directly and simply as matters of fact. Whatever help is needed to complete assigned tasks, otherwise impossible of execution within the limitations imposed, should be requested promptly.

b. In execution of work, troops should be placed on tasks under their own leaders in whole units without breaking up organizations. It is better to have a few too many men on several jobs than to mix the surplus on one. Troops work by shifts of about 5 to 8 hours each or by alternating reliefs for shorter periods. Actual handling of enlisted men should be left to their noncommissioned officers which leaves the officer free to exercise supervision over the whole job and keeps him from being concerned with small details. Technical specialists from headquarters are placed under the commander of the unit charged with the work and do not assume control of the operations. Troops should be kept on tasks assigned until completed and tasks changed only when necessary. To meet emergencies reserves of tools, supplies, and manpower should be planned for and work organized so that units may be withdrawn if necessary without disrupting the entire project. A job should be organized with a view to maximum utility at any stage of completion. For example, one railroad siding completed ready for use is better than several partially completed; and a usable road subgrade connecting two vital points is better than having one section finished and the rest impassable.

■ 261. WORK ASSIGNMENTS.—Commanders of engineer units subdivide the engineer work by making area or task assignments, or combinations thereof.

a. *Area assignments* give each unit full responsibility for all types of work within a definite area. For example, a combat company may be required to perform all necessary engineer work in one geographical locality, as the zone of action of a combat team.

b. *Task assignments* give each unit responsibility for performing one or more specific duties. For example, a company may be assigned to the particular task of repair and maintenance of roads and bridges on an important route.

c. *Combinations* of above methods of assignment are frequently employed in giving engineer missions. A particular task may be emphasized when an area assignment is given. For example, an engineer company may be given an area assignment by ordering it to operate in the zone of action of a regimental combat team and the particular task may be emphasized by stating in the order that especial attention will be paid to assisting the advance of the artillery. A general service battalion may have the mission of executing all general engineer work required in a specified area ABCD and maintain a corps supply road from D to E, a combination of area and task assignments.

■ 262. **TRANSPORTATION AND SUPPLY.**—The mission assigned determines use to be made of transportation. Vehicles are loaded so as to meet requirements of engineer work in prospect. Transportation may be needed for transport of work personnel or supplies, for reconnaissance, or for work purposes. The most important use of transportation is for engineer supply. Equipment in the vehicles is unloaded when empty vehicles are needed in providing and maintaining the supply of engineer materials for working parties. Materials may be drawn from local sources near the site of the work, from forward engineer dumps, or from engineer supply points. Many engineer missions require assemblage of engineer material in quantity near the site of the work before construction is commenced. Much of the work of engineer supply must be done at night. Every effort should be made to keep work units supplied so that they may place their full strength upon actual execution of their work; this is one of the main functions of headquarters personnel.

■ 263. **ADVANCE.**—*a. Duties.*—In an advance engineers may—

- (1) Execute reconnaissance.
- (2) Collect data for amplification of existing maps.
- (3) Remove obstructions on roads, including mines and traps.
- (4) Repair, extend, and construct routes of communication.
- (5) Facilitate passage of waterways by improving fords; strengthening, repairing, or constructing bridges; and installing and operating ferries.

(6) Determine a plan for traffic circulation.

(7) Mark roads or localities and furnish guides.

(8) Through use of demolitions and obstructions, prevent enemy interference by protecting flanks and rear. In larger units protective lines of obstacles may be 15 to 25 miles distant from the main columns.

b. Disposition.—Strength of engineer troops with an advance guard is fixed by length of march to be made and estimate of work to be done during the march. The usual allotment of engineers with a single regimental column is about one company. Engineers in the advance guard should be moved in trucks and provided with all equipment, tools, and materials they may need to repair roads and bridges in the advance. The senior engineer officer with each column exercises technical supervision over operations of the engineers, and the commander of the engineer element of the advance guard makes such reports to the senior engineer as may be desired in connection with technical features of engineer work. On long and forced marches, it may be necessary to assign one company (or battalion) to the first part of the roads used and other units to the middle and last sections. All transportation is made available for road maintenance detachments and is disposed in the column accordingly. Company transportation may be consolidated if not needed during the march. A night march generally requires more engineers for road maintenance than a march in the daytime, especially if made without lights. More signs and guides are needed and there is more work of a minor nature.

c. Road work.—In an advance, the corps and army take over road operations as far forward as conditions permit, releasing the divisional engineers for work toward the front. When the road maintenance troops in the rear have become extended to the reasonable limit of their capacity, the divisional engineers can no longer be so released, and further progress of the division becomes dependent upon ability of the divisional troops to keep road communications open to the rear.

d. Special engineer troops.—Ponton and other portable bridge units in the column must be so placed that the main body of the column may cross streams without having to wait

for the bridge equipage. In arid regions water supply battalions may be needed to bring up water from points in rear of the columns and establish advance water supply points accessible to the most advanced troops.

■ 264. RETIREMENT.—*a. Duties.*—In a retirement some engineer troops are employed near heads of retiring columns on duties similar to those described in paragraph 263 for an advance and to assist movement of trains. In addition, engineers may be used at rear of columns to—

(1) Delay the enemy by destroying bridges, blocking roads, demolishing railways, and erecting barriers.

(2) Assist in hasty organization of the ground for delaying action.

(3) Assist in flank security by demolitions and obstacles.

(4) Destroy equipment, materials, and stores of use to the enemy.

(5) Participate in combat, especially in the defense of road blocks, etc., against encircling forces.

b. Disposition.—Engineers with leading troops reconnoiter for and remove obstacles to the retrograde movement or replace structures demolished by ground or air raids. They also prepare demolitions of roads, bridges, and other important structures to be subsequently executed by engineers with the rear guard.

c. Strength and position in column.—(1) Strength of the engineer component of a rear guard depends upon the work to be accomplished and may be a quarter to half the strength of the engineers with the main body. It marches near the tail of the column. Tool and personnel vehicles must accompany working units. Engineers or vehicles not needed with rear guard should march with the main body. The leading engineer unit is responsible for road maintenance for the column and operates in a manner similar to that of the leading engineers in an advance guard.

(2) The rear unit may or may not be attached to the rear guard. If so attached, they operate under the command of the rear guard commander, who controls and coordinates the work of the engineers with the operations of his own troops.

■ 265. **ATTACK.**—*a. Duties.*—In preparation for and during an attack engineers may be employed to—

- (1) Execute terrain reconnaissance.
- (2) Improve roads for troop movement, supply, and evacuation.
- (3) Recommend a plan for traffic circulation.
- (4) Accumulate stores of engineer material for use in the attack and in consolidation of captured ground.
- (5) Assist in organization of captured ground; supply intrenching tools and materials to other troops.
- (6) Construct advance landing fields.
- (7) Locate, mark, and improve sources of water supply.
- (8) Mark routes, assembly areas, mine fields, etc.
- (9) Assist forward movement of artillery and tanks.
- (10) Assist forward movement of infantry by constructing bridges and by removing obstacles.
- (11) Prepare observation and command posts.
- (12) Facilitate movement of reserves.
- (13) Reconnoiter for engineer supplies left by the enemy.
- (14) Assist in flank security through the use of demolitions, mine fields, and obstacles.
- (15) Locate and destroy mine fields and trap mines.
- (16) Participate in combat.

b. Employment.—(1) In preparing for an attack, corps engineer service troops assemble materials at forward engineer dumps, provide technical specialists for special tasks incident to the attack, and assist divisional engineers. Certain units are detailed to conduct special reconnaissance. If additional transportation has been attached to the corps for engineer work, it operates under direction of the commanders of the units to which it is attached, subject to recall and pooling under control of the corps engineer.

(2) Divisional engineer units are generally employed upon routes of communication, the special engineer work being done by the headquarters or corps troops. If engineers are attached to brigades or regiments for the operation, the division engineer must retain sufficient engineers under his own control to care for the road work behind the attacking units and to operate the special equipment provided for the service of the division. Attached units should revert to control

of the division engineer as soon as they have accomplished the mission for which assigned. The divisional engineer unit may be used, when necessary, for division reserve and should always have forward points designated where it can assemble its combat echelons within a definite period of time for combat use in emergencies. Until such time, it should carry on its engineer work and should not be held inactive in one position in reserve.

(3) Tasks performed by engineers with armored forces in an attack are to—

(a) Prepare routes to the line of departure.

(b) Facilitate the advance beyond the line of departure by providing and installing special means for vehicles to cross streams, canals, marshes, gullies, trenches, antitank ditches, mine fields, and similar obstacles.

(c) Assist in camouflage of vehicles in assembly and other positions subject to fire and observation.

(d) Prepare and execute special demolitions.

(e) Protect vehicles against attacks from flanks and rear by preparation or improvement of obstacles and their defense where necessary.

(f) Furnish water and shelter.

(g) Execute reconnaissance with the division reconnaissance echelon.

■ 266. **Pursuit.**—In pursuit, engineers may be employed for—

a. Direct pressure forces, duties similar to those in the attack.

b. Encircling forces, duties similar to those in the advance, and after reaching the objective, duties similar to those in attack or defense.

c. Participation in combat.

■ 267. **DEFENSE.**—a. *Duties.*—(1) In defensive situations engineers ordinarily will be required to—

(a) Execute terrain reconnaissance.

(b) Establish distributing points for supply of tools and engineer material for organization of the ground.

(c) Repair, maintain, and mark roads for supply and evacuation, and prepare a plan for traffic circulation.

(d) Assist in organization of the ground by executing works of a special character such as demolitions, obstacles, command and observation posts.

(e) Assist in flank and rear area security through use of demolitions and obstructions, and furnish materials to other units.

(f) Improve facilities for water supply.

(g) Provide camouflage material and give assistance in its use.

(h) Provide maps, and record on existing maps the defensive works constructed by our forces.

(i) Lay out rear defensive positions and switch positions.

(j) Participate in combat.

(2) In delaying action, engineers may—

(a) Execute terrain reconnaissance.

(b) Execute demolitions and, when required, construct obstacles in front of delaying positions.

(c) Execute demolitions and construct obstacles on flanks to extend delaying positions and to provide security against mechanized attacks.

(d) Lay out and assist in organizing rear delaying positions.

(e) Improve and maintain roads leading to rear positions and assist in rearward movement of other units.

(f) Participate in combat.

(3) With armored divisions in defensive operations, including retirements, and delaying actions, engineers perform similar functions to those listed in paragraph 265 b (3) for the attack, and specifically are used to—

(a) Clear and prepare routes for counterattacks. Knowledge of the location of our own mine fields and ability to provide guidance through them are important.

(b) Block routes of retreat or protect routes of supply.

b. Lay-out and preparation of position.—(1) *Defensive position.*—In a defensive action, particularly in retrograde movements when time and means are available, engineers may be employed to reconnoiter and lay out rear positions and initiate work thereon. Positions often are occupied after dark by the units which are to defend them and engineers should furnish guides to conduct the units to their positions

and indicate the provisions made for defense. If practicable, a joint reconnaissance should be made by representatives of the unit to occupy the position to be laid out by the engineers and the engineer officer in charge of the job prior to any work being done. Selection of the main position may be strongly influenced by terrain that offers good prospects for antimechanized defense measures and for obstacles.

(2) *Special works.*—In general, the infantry and cavalry clear their own fields of fire, locate and build their own trenches and other field works, and construct their own close-in antitank obstacles. Outposts and delaying troops create outlying obstacles well to the front to delay the enemy advance. Engineers are used chiefly to construct obstacles to protect flanks and lines of communications. Engineers may construct such works as command posts, observation posts, shelters, and aid stations for units not organized or equipped for such work and may take over especially complicated or difficult tasks.

(3) *Fortification tools and supplies.*—The complete organization of a defensive position requires large amounts of barbed wire, pickets, intrenching tools, sand bags, and other construction equipment and supplies. The supply of this material, very little of which is carried in the corps and division trains, requires advance planning on the part not only of the unit engineer but also of the higher staffs so that necessary supplies may be stocked in the battle area and adequate transportation may be made available for their movement to forward distributing points.

c. *Camouflage.*—In general, all combat troops execute and are responsible for their own camouflage, using materials gathered locally and such manufactured materials as may be available. Divisional engineers assist by general inspection and supervision, by furnishing some supplies and, only in special cases, by erecting camouflage. For work requiring great skill, recourse may be had to the camouflage battalions of the army or of higher units; however, their chief functions are supervision, manufacture, and supply, and not execution of camouflage work.

■ 268. DEFENSE OF RIVER LINE.—In the defense of a river line, engineers perform duties similar to those in other defensive operations and in addition they may—

- a. Execute terrain reconnaissance to discover possible hostile crossing zones.
- b. Execute route reconnaissance for movement of reserves.
- c. Execute demolitions and create other obstructions, both in the water and along the shore, to destroy or block possible crossing zones and bridge sites including bridge approaches on their own side of the river and also on the hostile side if the situation permits.
- d. Destroy materials and floating equipment which might aid the enemy.
- e. Participate in combat in an emergency.

■ 269. DEFENSE OF COAST LINE.—In the defense against a hostile landing, engineers perform duties similar to those in the defense of a river line. Among other duties (see FM 31-5) they—

- a. Execute terrain reconnaissance to determine possible landing beaches.
- b. Construct underwater obstacles and mines at beaches and exits therefrom.
- c. Extend and construct railways and sidings for railway artillery.
- d. Prepare demolitions and obstructions to delay landing or advance of the enemy. Demolitions may not be executed initially, depending on plans for use for the counteroffensive.
- e. Lay out and partially prepare defensive or delaying positions. A passive defense in organized lines is unusual in coast defense, but engineers may reconnoiter and mark, and perhaps prepare for defense, rearward positions which may be occupied in case the tactical situation demands it.
- f. Improve, maintain, and mark roads for possible use of reserves. The usual form of active defense requires numerous routes for movement of reserves. For each possible line of enemy advance, a plan is made for employment of the engineers upon the routes concerned. The exact point of the enemy's major effort being uncertain, maintenance of the road net over as wide a range as the enemy activities may

conceivably cover becomes the most important function of the unit engineer in each sector. Engineers of all units are deployed upon the roads in accordance with the unit engineer's estimate of their probable need. Some portions are held in reserve. Vital routes of communication over which reserves may move are marked with suitable signs and route maps are prepared for use of reserve units.

g. Participate in combat in an emergency.

■ 270. **LANDING ON HOSTILE SHORES.**—*a. General.*—The general provisions for planning and conduct of joint overseas expeditions are set forth in publications prepared by the Joint Board. Emphasis must be placed on construction of temporary docks and wharves to facilitate movement of supplies and matériel from ship to shore, early construction of landing fields, and exploitation and development of water sources. See FM 31-10 for further information.

b. Duties of chief engineer of joint expeditionary force.—The chief engineer of the joint expeditionary force must be thoroughly familiar with the plan of operations from its inception. He must secure all available information concerning topography, climate, resources, routes of communication, available sources of water, and particularly hydrographic and oceanic characteristics in the area where landing is to be made which, with the plan of operations, determine number and nature of engineer troops and type of engineer equipment necessary. Since equipment must be loaded in reverse order to its use and since it must be loaded on the same boats as the troops which are to use it (team loaded), detailed plans involving tonnage and volumetric data and exact location in the hold of every item will be required. Preparation of such a plan in accordance with the directive of the expeditionary force commander follows the study of the equipment required.

c. Duties of engineers with leading combat teams.—The first unit to move from ship to shore is usually a combat team normally consisting of an infantry battalion and supporting troops, including a battery of field artillery and a company of engineers, with necessary liaison and communication agencies. Duties of this company of engineers is to facilitate movement of this force, particularly that of the

field artillery battery. They are equipped with a limited supply of hand tools which are carried by the men until the platoon tool trucks can be put ashore. The tools will ordinarily include axes, picks, shovels, blocks, and rope, machetes, and brush hooks.

d. Duties of engineers in the shore party.—After the leading waves have been landed, a shore party will be landed at each beach. In addition to detachments of military police, medical, and signal troops, a shore party contains engineer troops usually from the corps or army. The engineers must improve the boat landing facilities by constructing temporary docks and wharves. Ponton equipment may be useful for this purpose if the beach is well sheltered and the swell is slight. As early as possible additional engineers are landed to engage in increasing facilities for landing boats by construction of permanent docks and wharves, for exploiting water sources and establishing water points, and constructing landing fields.

e. Preparation for defense.—A beachhead is not completely established until all danger from fire of hostile artillery is removed. This usually requires a depth of 15,000 yards from the landing place and a width of 30,000 yards. During progress of the attack for establishment of such a beachhead engineers must be prepared for defense and to resist hostile counterattacks. Their employment in this situation is similar to their employment in any other defensive situation, principally to impede movement of the hostile force through the creation of obstacles.

■ 271. BIVOUAC.—In bivouac, all engineers normally operate under organizational control. They may—

a. Execute general terrain and water supply reconnaissance.

b. Mark and repair routes to and within the area.

c. Supply materials, tools, and antitank mines for road blocks and obstructions where necessary.

d. Assist in construction of special road blocks or obstructions.

e. Provide security detachments for motor vehicle areas in certain situations.

f. Install or mark water points.

■ 272. RESERVE OR REST AREAS.—*a.* When in a rest area engineers conduct their own training, recreation, and recuperation activities in accordance with the general programs and directives of their higher unit or engineer commanders. They may be employed upon engineering work which should be of a nature to increase comfort, improve morale, and have some training value for engineers, especially replacements.

(1) Repairing billets, mess halls, and recreational structures, especially if for their own use.

(2) Constructing target ranges and other training facilities.

(3) Improving water supply and other utilities.

(4) Furnishing electric light and entertainment facilities.

(5) Maintaining roads in the area.

(6) Replacing clothing and equipment of own troops and units.

(7) Engineer supply to other units.

Rear area troops should be used for the bulk of such work normally required for rest areas. None of these activities should be allowed to interfere with rest and necessary tactical and technical training in preparation for future field operations.

b. In order to maintain a continuity of engineer policy within the area the unit engineer keeps a file of pertinent papers and maps to turn over to his successor showing layout of the area and suitability of each part of it for troops of various classes, status of construction work, sources of water supply and road materials, an inventory of engineer supplies and their location, condition of roads, circulation plan for traffic, and other matters of interest to a new engineer unit taking over the area.

■ 273. WATER SUPPLY IN HIGHER UNITS.—*a. General.*—This discussion covers the broad aspects of water supply operations of the engineer troops in corps and army areas, in the communications zone, and in the theater of operations. Operations of water supply battalions are given in section II, chapter 9. Technical details regarding water supply are included in FM 5-10.

b. Corps and army areas.—(1) The corps and army engineers have responsibility for water supply within their re-

spective areas. Here demands for water are greater and the character of installations is more extensive than in divisional areas. Allowances of water are more liberal, permitting use of water for such activities as in road construction. Tank reservoirs may be constructed and filled by power pumps. Delivery of water by pipe line may be found advisable, and in a stabilized situation the pipe system may be extended well forward. Transportation of water by railroad tank cars to railheads may be of frequent occurrence in arid regions.

(2) If the water situation demands it, the corps or army engineer may designate an officer on his staff as water supply officer. All actual construction of water supply installations is carried out by the general engineer troops at the disposal of the corps or army engineer.

c. Communications zone.—In the communications zone demands for water may be enormous. Some of the usual needs are for operation of steam power plants of all kinds, operation of railroads, supply of large cantonments, and water supply for concrete construction and water-bound macadam roads. Where local resources are deficient, water to meet these needs is transported by rail, boat, or pipe line.

(1) The section engineer is charged with development and operation of water supply in his section. His activities may include—

(a) Operation of existing plants and installations.

(b) Construction of and operation of reservoirs, dams, standpipes, pumping stations, filter beds, chlorination devices, pipe lines, and other means of purification and distribution.

(2) The same general considerations as to other construction activities in the section apply to water supply activities. Responsibility rests with the section commander, and the construction is according to policies laid down and projects approved at GHQ.

d. Water supply activities of chief engineer.—Water supply policies promulgated by the staff of the commander in chief are based on recommendations of the chief engineer at GHQ. He has projects for major water supply construction submitted by the engineer of the communications zone tech-

nically scrutinized, and recommends their approval or modification. The chief engineer recommends allocation of water supply battalions from the GHQ reserve to the several armies or sections where required. He provides for depot stockage and priorities of issue of water supply equipment to meet prospective operations. The intelligence officer on the staff of the chief engineer collects and compiles from all sources of information data as to water resources of the enemy territory, including results of geological investigations.

■ 274. PUBLIC UTILITIES IN OCCUPIED AREAS.—*a.* When cities are occupied by our military forces in enemy territory the operation of public utilities comes under supervision of the unit engineers. Use of engineer troops in actual operation of the utilities will be unusual. Normal civilian operating and administrative personnel are retained wherever possible and needs of the civilian population satisfied so far as is consistent with military requirements.

b. Usual employment of engineers is placing of technically trained officers and noncommissioned officers at key positions to insure that the utilities are protected and operated in accordance with the regulations prescribed by the military commander. The addition of a large military population to the existing civilian population causes congestion and scarcity of supplies and transport which require regulation. Some of the difficulties likely to arise are—

- (1) Shortage of fuel for power plants.
- (2) Shortage of electric lighting materials such as bulbs, wire, and fuses.
- (3) Water shortages or pollution of water supplies.
- (4) Accumulations of garbage and refuse leading to dangerous unsanitary conditions.
- (5) Strikes or sabotage by civilian employees.

c. Immediately upon entering the occupied city the unit engineer makes contact with the responsible engineering members of the civilian government and endeavors to induce them to retain their posts to serve the interests of their civilian population. Having established amicable relations, he places in their offices a nucleus of military engineer personnel and immediately requires a detailed survey and report of condition, location, and method of operation of all utilities. After

the reconnaissance has been made he recommends to the commander such modifications in current procedure as seem advisable in the military interest. If the qualified and responsible civilians will not cooperate or are not available, the necessary utilities continue to be operated by military personnel until suitable civilians can replace them.

■ 275. PORTS.—*a.* At or prior to the beginning of operations involving oversea shipments the chief engineer makes studies of possible ports of embarkation and debarkation and recommends to the commander in chief the best available sites from an engineer point of view and a comprehensive initial port development policy. Among the more important considerations influencing his recommendations are—

- (1) Amount of tonnage the port may be expected to handle from information furnished by the general staff. If no definite figure is obtainable from this source, the chief engineer makes his own estimate based upon the strategical plan of the commander.

- (2) Draft of vessels using the port; whether the Navy is to use the same port for a base and to what extent.

- (3) Tidal range and hydrographic conditions of the site.

- (4) Existing facilities and utilities available.

- (5) Capacity of the site and existing facilities for expansion.

- (6) Routes of communication from the port to the combat zone.

He reports to the commander the results of his studies, recommending a port or ports for adoption with reasons therefor and also recommending alternative sites.

b. A port having been selected, he formulates for approval a port policy which becomes the basis of subsequent engineer operations. This policy covers—

- (1) Number and character of new berths to be constructed, including necessary dredging.

- (2) Plan of port control.

- (3) Extent of port storage to be provided.

- (4) Kind of cargo-handling machinery to be installed.

- (5) General track lay-out for the port and amount of rolling stock and motive power to be required for port operation.

(6) Plan of construction of troop reception facilities including barracks, mess halls, hospitals, and recreational centers.

c. The approved policy is put into execution by the commander of the section of the communications zone within whose jurisdiction the port lies.

d. The section engineer employs upon the work such engineer troops as he controls, usually general service regiments or separate battalions, transient troop units, prisoners of war, civilians, and such engineer or other troops as the commander of the communications zone may place at his disposal.

e. In executing the work it is desirable that every effort be made to make some portion of the facilities immediately usable.

f. The section engineer makes periodic reports of progress through channels to the chief engineer who studies them in connection with the port necessities of the campaign and prepares to make recommendations to the commander in chief as to cessation of certain activities or to expansion of the project. When, due to acts of the enemy or other causes, necessary materials of construction are unavailable or a shortage exists, the section engineer makes recommendations to the chief engineer for a modification of the project and uses his initiative within the latitude allowed him to develop maximum efficiency of the port where minor deviations from the approved project seem warranted.

g. Construction of new wharves and docks will often be necessary for efficient port operation in a theater of operations even where some existing facilities are available. As a rough estimate for calculation, about 1 to 1½ or an average of 1¼ tons can be unloaded per day per lineal foot of dock. Using the average figure and a basis of 40 pounds per man per day as the requirement for all kinds of supplies needed by an oversea expedition, at least 1,600 feet of dock are needed to supply 100,000 men. In some theaters of operations where the number of service troops is relatively small the requirements might be over 100 pounds per man per day. About 30 to 60 lineal feet of wharves and docks 15 feet wide can be built per day with a floating pile driver. Further details and data relative to port construction are given in FM 5-10.

SECTION II

RIVER CROSSING OPERATIONS

■ 276. GENERAL.—*a. References.*—(1) FM 100-5 covers use of the combined arms in river crossing operations.

(2) TM 5-270 covers detailed technical data on standard types of river crossing equipment.

(3) Chapters 2, 3, and 4, FM 5-10, cover in a more general way technical data on bridges and improvised means for crossing rivers.

b. Purpose.—The purpose of this section is to cover the duties of engineer troops in a river crossing operation, particularly divisional engineers and those attached to divisions.

c. Operations.—Engineer operations in a river crossing comprise the following successive activities:

(1) Planning, including procurement of troops and equipment, and reconnaissance.

(2) Movement to assembly positions near the river line.

(3) Movement from assembly positions and crossing leading waves by assault boat.

(4) Crossing succeeding waves by assault boat, footbridge, individual ponton ferry, and ponton raft ferry.

(5) Crossing combat vehicles by ponton raft ferry.

(6) Construction of ponton bridges, maintenance, and repair.

(7) Replacement of ponton bridges.

(8) Other duties.

■ 277. PLANNING.—*a. Tactical plans of successive echelons.*—Units higher than the division are concerned primarily with fixing the general time of crossing and with designating the fronts and major objectives for subordinate units. They attach the necessary additional engineers and equipment to the front line divisions and hold initial reserves of engineers and equipment under their own control to be used later to reinforce the front-line divisions or to exploit a success (see par. 278). A front-line division prepares a general plan for crossing on its front. Subordinate units work out details on fronts assigned them under the division plan.

b. Engineer staff officer.—The success of a river crossing operation is dependent upon proper reconnaissance and provision of necessary means. The unit engineer must—

(1) Be prepared to give advice on preparation of the commander's plan.

(2) Prepare and execute a detailed engineer plan to carry out the commander's orders.

c. Commander.—The commander's plan is based upon both tactical and technical considerations. The engineer must consider both in preparing his plan.

d. Engineer.—The engineer plan covers in detail crossing means to be provided, crossing schedules, attachment of engineer troops and equipment to subordinate units, reversion of such units to engineer control, and execution of such tasks as will be performed under control of the engineer preparing the plan.

e. Crossing schedules.—The engineer of each echelon coordinates the crossing by the preparation of a crossing schedule which supports the plan of the commander. The form of this schedule must be adapted to the situation but should show in general, for each tactical subdivision of the echelon, the exact time and place it will cross, the crossing means it will use and the engineer unit to assist. This schedule must have the approval of the commander and is the basis of orders for the crossing.

f. Alternate.—Alternate plans should be prepared to meet any contingency.

g. Rehearsals.—Rehearsals by all arms on ground similar to that of the actual crossing promote a thorough understanding of the plans. In any case, troops must receive practical instruction in the use of the assault boat and in crossing on the footbridge prior to the crossing.

■ 278. PROCUREMENT OF TROOPS AND EQUIPMENT.—*a. Reinforcement of divisional engineers.*—Divisional engineers do not have the necessary equipment or manpower to furnish the crossing means for a division. They are reinforced for this purpose by light ponton companies and general engineer troops from higher echelons. The light ponton company (see pars. 105 to 108) alone does not have sufficient personnel to

construct the bridge or to operate or maintain equipment under heavy fire. Combat engineers are the troops best trained to handle all types of crossing equipment, particularly that assigned to the initial waves. General service troops have some training and may be used to reinforce combat engineers, to furnish crossing means for succeeding waves and to construct, operate, and maintain raft ferries and ponton bridges. Separate battalions normally do not have training in use of crossing equipment but may be used to construct approaches, carry equipment, and reinforce combat or general service engineers on ponton bridge construction.

b. Attachment to tactical units.—Engineers are attached to subordinate tactical units of the division for execution of engineer tasks whenever the local tactical employment of the engineers has a controlling influence on execution of the mission. For example, engineers should be attached to leading infantry battalions for initial assault boat crossings and early construction of footbridges. Attached units should revert to division engineer control as soon as need for attachment to subordinate tactical units ceases in order that the division engineer may shift the resources of engineer troops and equipment to the front most essential to the success of the division. The time of reversion is stated in orders and may take place after leading battalions or leading regiments are across, or even later, depending on circumstances.

c. Tasks under division engineer control.—Tasks which serve the division as a whole and which are not dominated by local unit tactical situations such as ponton bridge construction normally are executed by engineers under control of the division engineer.

d. Reserves.—High losses in engineer troops and equipment in an opposed river crossing must be expected. For that reason both division and corps retain initial reserves of both personnel and equipage to make replacements or to reinforce a front where success is to be exploited.

■ 279. RECONNAISSANCE.—*a. General.*—(1) *Front.*—A comprehensive and thorough reconnaissance of the front or fronts selected for the crossings, well in advance of the proposed operation, is the first requisite for success. This should include reconnaissance of the river itself, the near bank, in-

cluding avenues of approaches and concentration areas for friendly troops, and within means available, the hostile bank and bridgehead zone. Prior to ground reconnaissance, a study of available maps and aerial photographs should be made in connection with the tactical plan and tentative fronts selected for future investigation. This study should be supplemented by aerial reconnaissance, preferably with engineer officers as observers. Consideration is given to both tactical and technical requirements. When hostile covering forces have been driven from the near bank, an *area* reconnaissance is made to determine which of several general plans should be selected. This may take the form of a joint reconnaissance by the commander and his unit engineer or members of their staffs. Tactical considerations may predominate. *Site* reconnaissances are made of the general fronts selected for the crossing, preferably by means of joint reconnaissance by the engineer in charge of the local crossing with the interested tactical commanders. Technical considerations may predominate. *Detailed* reconnaissances are made by the engineer in local charge to obtain detailed data for technical execution of the work. Within any echelon of command the area, site, and detailed reconnaissances are ordinarily executed successively to permit proper planning. However, if time is not available they may be executed concurrently. Leading regiments and their attached engineers require orders at least 24 hours in advance of the crossing for proper planning, reconnaissance, and the issuance of subordinate orders. Several weeks could be well utilized, when the situation permits, for reconnaissance planning of crossings on strongly defended fronts.

(2) *Precautions.*—Reconnaissance activities must be carefully planned so as not to disclose intentions to the enemy. Reconnaissance parties must avoid detection from the air on the enemy side of the river. Technical data on river and site characteristics may have to be secured at night. Daylight activity of staffs and their transport must be reduced to a minimum or neutralized by deception. Caution must be exercised to prevent significant information from falling into the hands of hostile patrols and armored detachments operating on the near bank.

(3) *Site selection.*—The ideal site for any particular type of river-crossing operation may never be found. The function of reconnaissance is to ascertain all the pertinent facts upon which selection of site may be based. The final choice of site will always be a compromise not only between tactical and technical considerations but also between advantages and disadvantages of the latter for each site. The site requirements discussed in *c* below for each type of operation must be considered as ideal and viewed with the foregoing caution firmly in mind.

b. Final assembly areas.—Final assembly areas are placed where engineer troops with assault boats, footbridge equipment, or other crossing means meet the unit which is to use the equipment. Succeeding combat units may await their turn to cross in these areas. Desirable characteristics are—

- (1) Accessibility for trucks by covered routes.
- (2) Easy identification on ground and map.
- (3) Concealment from hostile ground and air observation.
- (4) Ordinary noise not audible to enemy side of river.
- (5) Numerous foot routes leading to selected crossing points.
- (6) Location to facilitate crossing on a broad front.
- (7) Defilade from enemy rifle and artillery fire.

c. Sites.—(1) *Assault boat crossing point.*—(a) Desirable tactical characteristics include—

1. Broad fronts to favor surprise; individual boats to be at least 15 yards apart.
 2. Conformity to the plan of maneuver and convenience to objectives and good routes of advance.
 3. Lack of opposition by enemy small-arms or artillery fire.
 4. Local defilade on the far bank.
 5. Covered approaches on the near bank.
 6. Good positions for supporting weapons on the near shore.
- (b) Desirable technical characteristics include—
1. Moderate current (1 to 2 miles per hour).
 2. Suitable successive embarkation points downstream (if necessary on account of current).
 3. No obstructions in the water area.

4. Firm banks, free of obstructions, slope not over 2 on 1 and preferably flatter; height not over 6 feet.

5. At least 10 inches of water 15 feet offshore to prevent grounding of boats.

(2) *Footbridge*.—(a) Desirable *tactical* characteristics include those listed in (1) (a) above.

(b) Desirable *technical* characteristics include—

1. Proximity to a road, path, fence, or other feature on the near shore leading to the site.

2. Cleared area on the near shore, either flat or with a uniform gentle slope large enough for assembly of bridge bays and preferably screened from the far bank.

3. Water adjacent to the near bank not more than waist deep, sufficient to float the bridge.

4. Absence on both banks, especially on the near bank, of high bluffs or other obstructions.

5. Presence of trees or other usable anchorages on both banks for float cables and guy lines.

(3) *Individual ponton ferry*.—(a) Desirable *tactical* characteristics include those listed in (1) (a) above if ponton ferries are used early in the crossing. If their use is postponed until after all enemy small-arms fire has ceased, ponton ferries are usually located at sites convenient to the main avenues of advance.

(b) Desirable *technical* characteristics include those listed in (1) (b) above and in addition include—

1. Approach road to site for truck and trailer.

2. Minimum of 15 feet of bank paralleling the river with a gentle slope to facilitate launching.

3. Location upstream from proposed bridge for convenient future use of equipment but not so close as to endanger bridge operations if control of a ponton is lost.

4. Good concealment along the bank for pontons when not in use.

5. Nearby navigable tributary stream to facilitate launching and concealment.

(4) *Ponton bridge*.—(a) Desirable *tactical* characteristics include—

1. Location so as to conform to the scheme of maneuver and sufficiently distant from other ferry or bridge sites so that artillery fire or aerial bombing directed at one will not destroy the other.
2. Convenience to an all-weather road on both sides of the river which fits into the plan for traffic circulation.
3. Avoiding points near which enemy artillery has registered.
4. Terrain on the far bank which will provide local defilade of the site and approaches from flat trajectory artillery fire; an objective whose capture will eliminate ground observation of the bridge site; a deeper objective whose capture will eliminate all enemy artillery fire from the site; and routes of approaches with suitable terrain and good concealment for the advance on these objectives.
5. Terrain on the near bank which will provide concealment of the approaches from enemy ground observation while affording observation for friendly troops deep into the hostile territory and suitable positions for supporting weapons.
6. Terrain on both banks must afford sites and unobstructed observation for a well-organized anti-aircraft defense, yet at the same time must offer considerable wooded areas, ravines, etc., in the immediate vicinity of the bridge for concealment from hostile air observation of command posts and other tactical and technical installations, including those for engineer maintenance, requiring location on either bank close to the structure.

(b) Desirable *technical* characteristics include—

1. *Approaches*.—Short, easily constructed approach roads from the site to the existing road net on both sides are of primary importance. Within 150 feet of the bridge approaches should be straight and without excessive grades, particularly on the far

shore. Prior construction of the near approach is often essential in order to get the ponton equipment to the river. The time required to construct approaches is often the controlling factor in selection of the site.

2. *Current*.—Current should be steady, parallel to the bank, and moderate. A location in a straight reach or gentle bend is favorable.
3. *Bed*.—Bed of the river should be free from snags, rocks, shoals, and other obstructions which would interfere with the movement of the pontoons and erection of trestles and should be sufficiently firm to hold anchors and support the trestles.
4. *Banks*.—Banks should be firm enough to support the sill and approach. They should not be so high or steep as to require excessive digging for the approach. They should not be so low that normal rises will overflow the site or unnecessarily increase required length of bridge.
5. *Launching pontoons*.—A 15-foot stretch of bank having a gentle slope to the water, either at the site or convenient to it, is needed for launching pontoons. In a swift current, an upstream point is desirable.
6. *Mooring pontoons*.—A place for mooring pontoons along the bank is necessary about 250 feet from the site. Mooring points may be upstream or downstream of the site or both, depending upon the plan for casting the anchors or for using the anchor cable. Easy access from the land side, deep water and scattered trees along the bank are desirable.
7. *Stacking balk and chess*.—A cleared area on the near shore at the site is needed for unloading and stacking balk, chess, and other equipment.
8. *Transportation park*.—Provision must be made for moving trucks and empty trailers completely away from the site or parking them nearby under cover.
9. *Hold-fasts*.—In case it is inadvisable to use anchors in the bed of the river to hold the pontoons, the presence of large trees or other hold-fasts near

the bank is desirable for fastening steel anchor cables and guy lines. When a bridge is located downstream from existing pile clusters or bridge piers, these may be used as hold-fasts.

10. *Rise and fall of water surface.*—Selection of the site must consider effect of normal changes in the water surface on construction and operation of the bridge. Tides, floods, drought, and destruction or manipulation of dams may change the level many feet.
11. *Existing ponton ferries.*—If ponton equipment in existing ponton ferries is to be used in construction and maintenance of the bridge, a site downstream from the ferry favors movement of this equipment.
12. *Demolished bridge.*—The ponton bridge should be located far enough away from the site of a demolished bridge so that there will be no interference with the later reconstruction of the fixed bridge.
13. *Tributary stream.*—A site just below the mouth of a tributary stream favors launching boats and constructing parts or rafts in the tributary under cover and floating them down into position when needed.

(5) *Ponton raft ferry.*—(a) Desirable *tactical* characteristics include those listed in (4) (a) above. The ponton bridge should have priority of location even though constructed subsequent to the ferry.

(b) Desirable *technical* characteristics include those listed in (4) (b) above, except that the approaches need not be as substantial and the current must be 2 or more miles per hour if utilized instead of outboard motors for propulsion of the ferry. Excessive currents should be avoided.

■ 280. MOVEMENT TO RIVER.—a. *Assault boats* are brought forward by truck under cover of darkness on the night of crossing. They move directly from their place of concealment to the final assembly areas. Assault boats are laid out on the ground in these areas in a manner convenient to the rapid assignment of troops, and details clear and mark

routes to the river. For the crossing operation, engineer troops are assigned to duties as paddlers or shore details and supervision is provided to insure that troops will be assigned quickly to boats and that carrying, loading, unloading, and reloading of boats will be done in an orderly manner.

b. *Footbridges* are brought in a similar manner to the final assembly areas. If movement forward is to be by truck in whole or in part, the equipment remains loaded. If movement is to be by hand, it is piled on the ground convenient for issue to carrying parties. Engineers clear and mark trails to the construction site. Guides are provided and the construction party is assigned its duties.

c. *Light ponton equipage* is normally concealed far to the rear of the division area and is brought forward by truck under cover of darkness on the night of the crossing to initial control points designated in the engineer plan. Initial control points must be close enough to the river to insure that the equipment can be brought forward quickly by truck when needed in spite of congestion and damage to roads. On the other hand they should not needlessly expose equipment to artillery fire or air attack. From initial control points, equipment is moved forward by truck at the proper time to be used for individual ponton ferries, ponton raft ferries, or ponton bridges.

■ 281. CROSSING.—a. *Leading waves by assault boats.*—In order to insure that leading waves have necessary equipment and are crossed at the appointed time, crossing schedules are specified in orders. The crossing schedule must be accurately worked out and executed to avoid either delay in crossing or bunching at the river bank. Movement from the assembly areas, launching, crossing the river, and returning the boats is carried out as described in chapter 2, TM 5-270, with assault troops carrying the boats to which they are assigned. Engineer troops continue to operate the crossing means established for leading waves until such time as an ample number of more substantial means of crossing are in operation.

b. *Succeeding waves by assault boat, footbridge, individual ponton ferry, and ponton raft ferry.*—(1) *Crossing schedule.*—One or more alternate means of crossing to be used in event the primary means is not available should be planned for each

unit of the succeeding waves, or else an alternate plan of maneuver should be provided based on successful crossing elsewhere. Guides should be prepared to lead units of succeeding waves to the crossing point of either the primary or alternate means assigned to that unit. In computing engineers and equipment available to succeeding waves, crossing schedules should make a liberal allowance for losses.

(2) *Assault boats.*—Succeeding waves are led by engineer guides from their forward assembly areas or other control points to the crossing point at the river bank, and are crossed in the boats provided for the preceding wave or they may carry up additional boats, accompanied by new engineer crews. The crossing point may be the same as that for the preceding wave if the current is gentle, or may be downstream thereof by the amount of drift if the current is swift. However, unless suitable downstream crossing points are definitely provided, assault boats return to the original points as confusion will result if troops attempt to follow the boats along the average river shore.

(3) *Footbridge.*—The M1935 footbridge is too vulnerable for use as an assault bridge by the leading waves unless the stream is very narrow. It is an excellent means of crossing succeeding waves if the stream is not too wide or too swift and after hostile small-arms direct fire is eliminated. Movement to the river, construction, and maintenance are executed in accordance with chapter 3, TM 5-270. Truck movement for equipment is used as far forward as practicable. Carrying parties may be from the engineers or from the first troops scheduled to use the bridge. Engineers furnish the construction party and leave a party for maintenance. A liberal supply of equipment should be available for replacements.

(4) *Individual ponton ferry and ponton raft ferry.*—Individual ponton ferries and ponton raft ferries are not suitable for use with the leading waves because of vulnerability to direct small arms fire. The equipment is normally reserved for use in vehicle rafts and bridges. The equipment is moved from the initial control point at the appropriate time and is met by a launching crew either at the river bank or at a point in rear from which it can be manhandled to the river bank. Boats are launched, rafts and landing stages are built, and the ferry is operated in accordance with

chapter 4, TM 5-270. A liberal supply of equipment should be made available for replacements.

c. Combat vehicles by ponton raft ferry.—As soon as the assault waves have advanced any considerable distance on the far side of the river, combat vehicles for heavy weapons and ammunition and light artillery to support the advance, together with certain signal, engineer, medical, and messenger vehicles must be crossed, pending construction of a ponton bridge. A ponton raft ferry is less vulnerable to fire than the bridge and requires a smaller expenditure of time and equipment for construction. For movement to the site, launching, construction, and operation see chapter 4, TM 5-270. Ferries are often continued in operation after the ponton bridge is built to handle return traffic and to supplement the bridge. A liberal supply of equipment should be made available for replacements.

■ 282. BRIDGES.—*a. Construction, maintenance, and repair.*—Since the approaches may take more time than the construction of the bridge, and since construction of the near approach may be necessary to get the equipment to the river bank, work should be started on the approaches as soon as conditions permit. Bridge construction is in accordance with TM 5-270. The light ponton company handles transportation of equipment and may furnish trained personnel for construction. A liberal supply of equipment should be available for replacements. The bulk of the work is done by general engineer troops. Personnel for maintenance and bridge guards is furnished either by general engineer troops or by the light ponton company.

b. Replacement.—The standard light ponton bridge will carry all divisional loads authorized and is normally the first built. However, as soon as possible consideration must be given to reinforcing it by standard methods, or constructing a heavy ponton or a fixed bridge either to provide a bridge capable of carrying the heavier loads of corps and army or to release the light ponton equipage for use elsewhere. Construction of the new bridge is usually undertaken by corps or army engineers because the effort of the divisional engineers will be devoted to work nearer the front. Dismantling and reloading of the light ponton bridge is performed either by

corps or army general engineer troops or by personnel of the light ponton company

■ 283. OTHER DUTIES.—In addition to the provision of crossing means as described above, engineers in a river crossing operation must perform their normal duties in an attack, particularly with regard to marking routes and helping traffic forward. Movement over the ground near the river is often difficult. Special activity may be necessary on the river to guard against floating mines or drift. Engineer reconnaissance must be pushed close behind forward elements on the far bank and steps taken to remove obstacles, prepare bridge exits and repair routes of communication on the far bank, as in the advance and attack (see pars. 263 and 265). Once across, divisional engineers should concentrate their efforts on work on the far bank leaving tasks along or in rear of the river line to other engineer units.

SECTION III

RECONNAISSANCE

■ 284. GENERAL.—*a. Definition.*—Engineer reconnaissance is the operation of obtaining engineer information in the field by troops sent out for that purpose. The information sought is *technical* in character, but, when it has a direct bearing on the plan of a commander for the employment as a whole of a combatant force, it is of *tactical* value and the reconnaissance by which it is obtained is considered to be tactical as well as technical.

b. Relation between reconnaissance and intelligence.—Military intelligence is collated and evaluated information concerning an enemy or theater of operations together with the conclusions drawn therefrom. The sources of information from which engineer intelligence are derived are numerous, but the most important and reliable source is engineer reconnaissance. However, information secured by reconnaissance does not become valuable until it has been studied in connection with other available information and evaluated in regard to its accuracy and adequacy.

■ 285. INTELLIGENCE FUNCTIONS AND ORGANIZATION.—*a. Unit commander.*—Since intelligence constitutes a vital element of

the commander's estimate of the situation and continually affects his decisions and orders, it is a basic function of command to initiate and coordinate the search for information from which the intelligence is derived. In addition, a commander may receive reconnaissance missions from higher authority which may or may not coincide with his own requirements for information. In any case, each commander is charged with the collection of military information within his zone of operations for use of his own and higher headquarters. The general responsibilities of commanders with respect to reconnaissance are outlined in FM 100-5.

b. Staff relations.—The military intelligence section is one of the coordinating sections of every general staff and of similarly organized staffs of smaller units. It assists the unit commander in discharge of the responsibilities given in *a* above. The unit engineer is responsible for engineer intelligence functions under general supervision of the intelligence section of the general staff (see par. 9).

c. Functions of intelligence officer (S-2), engineer headquarters.—Under supervision of the unit engineer, it is the duty of the intelligence officer of engineer battalions, regiments, or higher engineer headquarters to—

- (1) Specify information to be gathered.
- (2) Initiate systematic and coordinated search for required information by all available collecting agencies. In making plans for reconnaissance it is essential that the operations officer (S-3) be consulted and the reconnaissance plan coordinated with plans for conduct of other engineer operations.
- (3) Collate, evaluate, and interpret information derived from all possible sources.
- (4) Reduce resulting intelligence to systematic form and distribute it as necessary.
- (5) Maintain close liaison with intelligence sections of higher, lower, and adjacent units.
- (6) Exercise general supervision over all intelligence activities of the unit, including intelligence training.
- (7) Act as map supply officer for his unit and in some cases, for the larger unit of which his unit is a part.

In execution of his duties the intelligence officer conforms in general to instructions contained in FM 30-5 and maintains adequate intelligence records and a situation map.

■ 286. INTELLIGENCE PLAN.—*a. General.*—Engineer reconnaissance should be conducted in accordance with an intelligence plan which is designed to orient and focus the search for information so as to secure all essential information with the greatest speed and economy of force. The intelligence plan indicates what items of information are of vital importance to the commander in execution of his plans and means by which the information is to be obtained.

b. Essential elements of information.—Essential elements of information for the unit intelligence plan include not only the information required for planning operations of the unit, but also the information required for operations as a whole of the higher units of which it is a part. The elements of information required by an engineer unit may relate to hostile forces but usually they are related to the terrain, natural and commercial resources, and are technical in character. Determination of the essential elements cannot be made without a thorough understanding of the tactical situation and the expected employment of the engineers. Essential elements of information change with the situation and must be redetermined as frequently as necessary.

c. Means of securing information.—The principal sources of information available to an engineer unit are—

- (1) Reconnaissance by various engineer elements.
- (2) Study of military maps and photographs.
- (3) Liaison with other troops such as advanced cavalry and infantry units.
- (4) Questioning of civilians and prisoners.
- (5) Information obtained from the headquarters of the higher unit of which it is a part.
- (6) Information obtained from unit engineers of higher headquarters or adjacent units.

d. Form.—For intelligence plans of higher engineer units a model form used to save time and serve as a check against omission of important details is given below. In order to afford a check against unnecessary delays, the information which is to be passed on immediately to division or other headquarters is listed separately. The form is shown as used by a divisional combat battalion, matter in italics being inserted on prepared form as required.

ENGINEER INTELLIGENCE (S-2) PLAN

Period: 2:00 p. m., 2 May to 6:00 a. m., 3 May, 1940.

Essential elements of information announced by division headquarters:

1. Will enemy attempt to cross Monocacy river tomorrow?
2. Where will main effort be and what secondary attacks will be made?
3. What will his strength be at time of attack?

Information required	Agencies (Check agencies to be employed)							
	Request G-2	Request corps engineer	Operation section	Supply section	Division engineer section	Company "A"	Company "B"	Company "C"
To be furnished immediately to division or other headquarters.								
1. Locations on river lines suitable for ponton bridges or ferries, foot bridges, ferrying by assault boats.			X					
2. Detailed information on roads leading from river on our side and cross roads in our defense zone.						X	X	X
3. Detailed information on roads leading to river on enemy side.	X				X			
4. Cover and concealment on both sides.	X		X		X	X	X	X
5. Location of supply points for dumping fortification materials.				X				
6. Location of defensive positions to the rear.			X					
Primarily for use by engineer battalion								
7. Location of engineer materials in zone of each combat team.						X	X	X
8. Location of other engineer materials.		X		X				
9. Location of positions for construction of road blocks.			X			X	X	X

■ 287. FUNDAMENTALS.—*a. General.*—The fundamentals underlying engineer reconnaissance are as follows:

(1) It is governed by requirements of the mission of the unit as a whole and needs of the engineers for technical information on which to plan engineer work.

(2) It normally precedes other military operations and it should be conducted in time to allow planning and facilitate execution of the operations.

(3) It is a responsibility of all unit engineers and engineer organization commanders.

(4) To keep commanders continuously informed, it must be continuous.

(5) Information gained by reconnaissance should be sent promptly to the agency or office charged with the duty of evaluating and disseminating it.

(6) Reconnaissance forces engage in combat only to the extent necessary to gain essential information.

(7) Reconnaissance forces should be given missions in accordance with their characteristics and capabilities.

b. General reconnaissances are those made for the purpose of securing information of a general nature. This covers all matters of engineer interest in an area or along a route of travel, but not usually in complete detail due to lack of time or capabilities of the personnel making the reconnaissance. The kind of information especially sought will of course vary with the activity on which the unit is employed.

c. Special reconnaissances supplement general reconnaissances. They are made for securing detailed information concerning a specific thing or purpose, for example:

- (1) Roads and bridges (FM 5-10).
- (2) Railroads (FM 5-10).
- (3) Stream crossings (FM 5-10).
- (4) Positions for defense (FM 5-15).
- (5) Demolitions (FM 5-25).
- (6) Camouflage (par. 222, FM 5-20).
- (7) Engineer supplies (FM 5-5).
- (8) Construction sites (FM 5-10).
- (9) Water supply (FM 5-10).
- (10) Utilities (FM 5-10).

Instructions for the conduct of special reconnaissances and typical forms for rendering reports on them are included in the appropriate sections of the Engineer Field Manuals as indicated above.

d. General and special reconnaissances are combined in accordance with the intelligence plan so as to provide all necessary information with the greatest speed and economy of force.

■ 288. OPERATIONS.—*a. Air.*—The most advanced engineer reconnoitering elements consist of engineer personnel accompanying the Air Corps or Air Corps units which may have been given engineer reconnaissance missions. This reconnaissance may be by direct observation by engineer observers or it may be photographic.

b. Advanced ground.—The most advanced ground engineer reconnaissance is made by engineer units with armored forces or cavalry. Army engineer reconnaissance is always one of the most important missions of these units. The scope of this reconnaissance is very broad, embracing not only operations of these advanced forces but also the entire engineer situation in the area so far as it may affect operations in general.

c. Infantry division.—In the infantry division the work of engineer reconnaissance devolves upon the engineer combat regiment or combat battalion. It centers in the intelligence officer whose duties are outlined in paragraph 10b and 285c.

d. Rear areas.—Continuous engineer reconnaissance of corps and army areas and sections of the communication zone is conducted by the respective unit engineers. Close liaison is maintained with unit engineers in adjacent areas and in the adjacent forward zone. In an advance this liaison is especially important, rapidly changing conditions sometimes necessitating frequent reports from liaison officers with forward echelons.

e. Personal reconnaissance.—A unit engineer personally carries out reconnaissances which are of such critical importance that they may influence the decision of the commander with respect to the conduct of operations. In other cases he usually intrusts reconnaissance missions to officers and units under his orders in accordance with the unit in-

telligence plan. An engineer commander of a small unit such as a company or platoon makes a personal reconnaissance before every operation. Commanders of battalions and regiments make personal reconnaissances of a general nature, but may delegate detailed reconnaissance to their subordinates.

■ 289. INSTRUCTIONS.—Orders for the conduct of a reconnaissance should be clear and complete and should give instructions as to when, where, and what type of reports are to be rendered. Orders for the conduct of a general reconnaissance should give the area to be reconnoitered and items of information which are considered particularly important. In order to expedite issuance of instructions and to guard against errors of omission, especially in the case of inexperienced personnel, a model form for the issuance by an engineer unit of reconnaissance instructions, general or special, is given below. It should be noted that item 1 covers general reconnaissance and that all other items are listed alphabetically. When it is desired to direct particular attention during a general reconnaissance to an item such as roads, this should be indicated by an asterisk (*). Instructions for special reconnaissances and other detailed instructions are indicated as shown. Asterisks and italic matter are added to prepared form as required.

RECONNAISSANCE INSTRUCTIONS

6th Engineers

(Unit)

Woodlawn, Virginia

(Place)

14 June 1940, 10:00 A. M.

(Date and hour)

No. 5

To: C. O. Co. C

Maps: *Photomap B, Zeroco Road Map*

*1. GENERAL FEATURES.—Complete report with particular attention to other items checked.

2. ADVERSE ENGINEER SITUATION IN CONNECTION WITH ATTACHED UNIT.—Column delayed, insufficient engi-

For 1, make general reconnaissance of the zone of the 3rd Infantry. Submit complete report to BN CP not later than 4:00 P. M. Priority to roads, engineer materials and plant in that order.

neers attached, insufficient engineer supplies, etc.

3. AVENUES OF APPROACH.
- *4. BRIDGES.
5. CAMP SITES.—Suitable for battalion or larger units. Give details on availability of wood, water, and cover.
6. COVER.—Suitable for reserve position for battalion or larger unit. Generally suitable for camouflage of activities.
7. DEFENSIVE POSITIONS.
8. DEMOLITIONS BY ENEMY.—Details, labor, materials, and time necessary to repair.
9. ERRORS IN EXISTING MAPS.
10. FIELDS OF FIRE.
- *11. MATERIALS AND PLANT.
12. OBSERVATION.
13. OBSTACLES TO OUR MOVEMENT.—Natural and artificial.
14. OBSTACLES TO ENEMY MOVEMENT.—Suitable points for creating same.
15. RAILROADS.
- *16. ROADS.
- *17. STREAMS.—Width, depth, fords, ferries, navigability, condition of banks and approaches.
18. UTILITIES.—Garages, machine shops, electric plants, water-supply plants, gas systems.
19. WATERWAYS.

By order of Colonel E:

X

Major, 6th Engrs.

For 4, submit special report on the bridge over ACCO-TINK CREEK near ACCO-TINK VILLAGE. All other bridges to be covered only as required in a general report. The special report to be furnished with the general report.

For 17, report need only include fords which can be used by motors.

■ 290. PLANNING DETAILS.—*a.* A reconnaissance should always be preceded by a study of the instructions under which it is undertaken, the time limitations, and all maps or photographs of the ground to be covered that are immediately available. Since it is neither desirable nor possible for the observer to record all information that comes to his attention, he must know what he is looking for, how much detail is expected, and the relative importance of desired information. Knowledge as to relative importance of items is especially necessary when the time for the reconnaissance is limited. If not given, such

information must be obtained from a study of the reconnaissance instructions and an understanding of the tactical situation.

b. A reconnaissance must be conducted in such a manner as to permit the turning in of a report at the required place at the time specified. When an area is to be covered, it is advisable to determine in advance the approximate route to be taken and the proper amount of time to be devoted to each portion of the route, and then to adhere to the predetermined schedule. Sufficient time should be reserved at the end of the reconnaissance to digest and evaluate the information acquired and to prepare a clear, complete and concise report.

■ 291. REPORTS.—*a. General.*—The results of the reconnaissance are usually embodied in a brief written report. The value of the report is enhanced by neat sketches or by photographs. The date, hours, and name and grade of the person making the reconnaissance are included. Blank forms devised for use both in making a reconnaissance and in reporting the results of a reconnaissance save time and effort. A consideration of each item shown on a form insures against overlooking any important particular. The entry of exact numerical data on forms serves to increase accuracy. The compilation of information obtained by a number of reconnaissance parties is facilitated when form reports have been used.

b. Use of model form.—A model form for reconnaissance reports is given below. This form is not intended to fit all units and theaters of operations but should serve as a guide in devising other forms suited to particular needs. The mistake of requiring too much detail must be avoided since this delays not only the reconnaissance itself but also the evaluation of the information received. Note that at the head of the form is the directive that "Entries are to be made in accordance with the reconnaissance mission."

ENGINEER RECONNAISSANCE REPORT

GENERAL FEATURES

(Entries to be made in accordance with the reconnaissance mission.)

Date _____ Party _____

1. Route followed _____

2. Roads traveled: _____

From	To	Type	Width	Condition
_____	_____	_____	_____	_____

3. Obstacles encountered on roads: List in order in which met. Briefly describe each. Indicate materials available locally for passing obstacle _____

4. Streams crossed: _____

Name	Width	Capacity of bridge	Width of bridge
_____	_____	_____	_____

5. Telephone lines: _____

From	To	Number of wires	Condition
_____	_____	_____	_____

6. Towns: _____

Name	Approximate population	*Water	*Electricity	*Gas
_____	_____	_____	_____	_____

*Check if water, electric, and gas systems are serviceable.

7. Road materials: Located at _____ Kind and quantity _____

8. Camp sites at which fuel and water are available _____

9. Feasible points on roads or railroads for creating obstacles: _____

Location	Type of obstacles	Estimate of explosives required
_____	_____	_____

10. Additional information: _____

(Good defensive lines; location of enemy lines; _____)

_____ Navigability of streams; fords, ferries; railroad sites; _____

_____ Condition of railroads and rolling stock; etc.) _____

_____ Signature _____
_____ Grade _____

■ 292. COLLATION, EVALUATION, AND DISSEMINATION OF INFORMATION.—a. Reconnaissance reports are military information but not military intelligence. Within small units such as companies and platoons, the military information gathered by reconnaissance parties is collected and consolidated into a report of reconnaissance of the unit as a whole. Such consolidated information is transmitted to higher headquarters and, when it reaches the headquarters of the regiment or divisional battalion, the intelligence officer classifies the infor-

mation so that items of the same character may be grouped together for convenience of comparison and study; he then compares, analyzes, evaluates, and interprets the available information. The record of the result constitutes military intelligence which is promptly disseminated to appropriate elements of the engineer unit, and to higher unit and other engineer headquarters in accordance with its urgency. The dissemination of the intelligence is accomplished by personal contact or telephone conversation; special messages by airplane, motorcycle, radio, or other means; conferences between the intelligence sections of higher, lower, and adjacent units; and intelligence reports.

b. Situation reports covering the current status of engineer information may be required of the unit engineer at stated periods or at irregular intervals. When they are rendered regularly, it is advisable to maintain a work sheet for each separate paragraph of the report. On these sheets the information applicable to each portion of the report is entered as soon as received and evaluated, the sheets being held open for entry of data until the hour for drafting the report in its final form (see model form below).

ENGINEER SITUATION REPORT

3d Engrs

(Unit)

Greenville Pa.

(Place)

7 July 19 6:00 PM

(Date and hour)

No. 12

Maps: X 1:62,500

1. INFORMATION OF THE ENEMY.

- a. *Nearest elements.*—Contact with the enemy has not been regained by 6 p. m., but hostile units are reported by friendly inhabitants to be moving on Pottstown, in which case contact should occur about noon tomorrow, west of the Nehalem River.
- b. *Strength.*—Aerial observer reports indicate that strong enemy columns are concentrating at Nugent, 6 miles west of Pottstown and at Taskerville, 8 miles southwest of Pottstown. It is estimated that a brigade is concentrating at each point.
- c. *Supply and equipment.*—Assumed to be normal except in aircraft; especially well equipped with aircraft.
- d. *Artillery.*—No activity on our immediate front. The forward units of the 4th Div. on our right were reported to have come under heavy shell fire late this afternoon in the vicinity of the village of Owens Mill and RJ 270.

2. WEATHER.

For the 24 hours beginning noon 7 July the forecast is: Cloudy this afternoon; probable showers tonight and tomorrow. Visibility poor.

3. ROADS AND BRIDGES.

a. *Roads.*—As indicated in data (in red) on situation map (annex No. 1). Roads are largely macadam type but are in a bad state of repair. Three places where heavy traffic has broken through the subgrade or where washouts have occurred across the road are indicated by red crosses on the situation map. Gravel for road repair can be obtained from pits marked in blue on map.

b. *Bridges.*—The existing bridges (six) are all shortspan, timber-and-iron structures in good condition and rated for a maximum load of 10 tons. Detours can be provided around these bridges for tanks. See bridge reconnaissance reports consolidated in Annex No. 2. Heavy planks are available for longitudinals needed in three of the weakest bridge floors. The 71st Engr. Co. ponton equipment needed for crossing the Nehalem is now at Rodney. This equipment is still in unsatisfactory condition since the last crossing but 30 serviceable pontons can be counted on.

4. RAILROADS.

The line connecting Hampton with Pottstown is reported broken at the Nehalem Bridge and known to be cut at two burned trestles over small streams at (92.0-56.7) and (93.5-57.2). The general service company attached from corps started repair work on the trestle at (92.0-56.7) at 3 p. m. today using timbers brought forward as far as the line would permit. It is estimated that the first job will be completed by 9 a. m. 8 July and the second by 5 p. m. same date.

5. FORDS.

No definite information has been secured about the present condition of fords known to exist formerly at certain seasons over the Nehalem. Reported locations of these fords are indicated on the situation map with question marks in red. Reconnaissance patrols operating tonight should be able to obtain something more definite as to these fords at the present stage of the Nehalem. It is likely that with the recent rains the river has flooded the fords. This is one of the points our patrols should establish within a few hours.

6. COVER.

Photographs taken by our air service are not complete for our area, and the poor visibility of the last 24 hours has spoiled a number of views. Our patrols were instructed today to pay particular attention to locating the wooded areas and showing them on their sketches. This has been done to the extent of the territory covered by them. The best information available on forest growth is indicated in green on the situation map.

7. TOOLS AND MATERIALS.

Practically no supply of engineer tools is known to exist in our forward area other than two small hardware stores in Horton affording a stock of about 50 picks and 25 shovels. A few hundred board feet of 1-inch lumber is also on hand in Horton, and there are three large gravel pits as shown in yellow on the map. Standing timber suitable for construc-

tion purpose is to be found only in the vicinity of CR 580 and along the stream where sticks averaging 16 feet long and 8 inches in diameter can be had.

8. UTILITIES.

There are no municipal utilities in the area that can be used to advantage.

9. WATER SUPPLY.

The area is plentifully supplied with streams. All drinking water will need chlorination.

Signature _____

Grade _____

Authentication

Annexes:

No. 1. Situation map.

No. 2. Bridge Reconnaissance report.

Distribution: A2.

■ 293. RELATION OF ENGINEER RECONNAISSANCE TO OTHER ARMS AND SERVICES.—*a. General staff.*—The intelligence section (G-2) of the general staff of the unit concerned furnishes or obtains from the higher unit specific information as to physical characteristics of the hostile country, its economic development, transportation routes and facilities, railway and highway data, including design of bridges, tunnels, and terminals, general construction methods and equipment, enemy engineer organization and equipment, general engineer supplies, utilities, and topographic maps, all of which are needed as aids to engineer reconnaissance. G-2 also furnishes interpreters to aid in examination of prisoners from the hostile engineer service. Prisoners are turned over as promptly as possible to military police for action of the G-2 section. The operations and training section (G-3) of the general staff of the unit furnishes information concerning our own forces, including data on equipment and proposed operations. The supply section (G-4) furnishes information regarding transportation plans, supply needs, and shelter requirements.

b. Air Corps.—Aviation is the most valuable agency for speedy and extensive reconnaissance of a general nature, and it is also capable of securing much detailed information, particularly through aerial photography. Engineer officers are trained in aerial observation and in interpretation of aerial photographs. For offensive operations aerial engineer reconnaissance, including if necessary night photography by means of flares, should be very active, but to be of maximum value such reconnaissance must be repeated often enough

to show varying conditions on different days and at different hours on the same day. Aerial engineer reconnaissance may also be used to advantage in checking the efficiency of our own camouflage operations. Proper aerial engineer reconnaissance requires trained engineer observers, but aerial photographs may be made entirely by Air Corps personnel and furnished the engineers for study.

c. Weather information.—The Air Corps (and in some cases the Field and Coast Artillery) will supply climatic data and weather forecasts as aids to engineer reconnaissance. The information has especial value in connection with river-crossing operations and construction in or over water and to some extent in water-supply problems. Reliable knowledge of the climate may enable the engineer to avoid relying on plans which impending climatic changes would render impossible of execution, especially in subarctic and tropical regions.

d. Medical Corps.—Medical personnel will conduct field laboratory tests of the water supplied by the engineers and determine its purity. Such information must guide the engineer in his reconnaissance for a water supply. Medical personnel may likewise aid in determining the healthfulness of proposed camp sites.

e. Armored divisions.—Information gained by the distant reconnaissance echelon of armored divisions is of great value and can be promptly made available by radio equipment on scout cars. Such forces are particularly valuable in checking on information gained by air reconnaissance, instructions being relayed by radio. See section II, chapter 3.

f. Cavalry.—Reconnaissance by the Cavalry is by no means as extensive as that by the Air Corps, but the information gathered by cavalry units should be more positive and detailed than that obtained by aerial means. Engineer reconnaissance is one of the principal functions of the engineer units assigned to cavalry and armored divisions. Engineers on reconnaissance duty only with cavalry units and operating under direction of their own commanders should keep free from combat except where doing so would endanger the success of the mission.

g. Infantry.—Engineer reconnaissance must be kept in close touch with infantry operations. In raids where engineer information of value may be obtained, engineer scouts should accompany the raiding parties. Where engineer assistance is required to enable the infantry to pass difficult obstacles, engineer reconnaissance should precede the operation; for the usual infantry operation, the engineer reconnaissance follows the infantry advance as closely as possible.

h. Artillery.—Problems connected with roads and bridges are of the utmost importance to the artillery and much valuable information on these matters may be exchanged between artillerymen and engineers. Artillery observers in command posts and in the front line are in a position to note enemy preparations for destruction of lines of communication or the extent of destruction already accomplished. The main difficulty in obtaining such information is the matter of securing it in time to be of value to the unit engineer.

SECTION IV

ESTIMATES, PLANS, ORDERS, ANNEXES, AND REPORTS

■ 294. GENERAL.—*a. Reference.*—The subject matter of this section as it pertains to tactical, technical, and logistical operations of all arms and services in general is covered in FM 100-5, 101-5, and 101-10. This section deals only with estimates, plans, orders, annexes, and reports specifically pertaining to engineer duties and phases of military operations.

b. Functions of leaders.—(1) *Sequence.*—In any situation demanding action certain definite steps must be taken in logical sequence by an engineer commander. He first makes an estimate of the situation, which culminates in a decision as to the action to be taken. He next evolves a plan to put his decision into effect. By means of orders he conveys this decision and plan to his subordinates. The final step is supervision to insure execution of the orders as issued. He requires from subordinates timely submission of the minimum number of reports required by his own or higher headquarters, avoiding duplication and insisting on conciseness and

brevity; he issues bulletins giving the engineer situation and instructions as to approved normal methods of procedure.

(2) *Staff participation.*—The extent to which each of the above steps will be performed by the engineer commander personally or by his staff will vary between wide limits, dependent upon such factors as time element, distances involved, size of the command, situation, and character and training of members of his staff. In a small unit with no staff, such as a platoon, the commander must perform every step himself. In the larger units part of the work will be done by the staff. The more experience and training the members of the staff attain, and the more conversant they become with the commander's policies, personal wishes, and characteristics, the more the commander can rely on them for planning of details. For these reasons decentralization in training should be initiated early and carefully developed (see par. 20 c). However, the responsibility for the decision, plan, orders, and supervision always rests entirely upon the commander.

■ 295. *ESTIMATE OF SITUATION.*—*a.* Whenever the engineer is confronted with a new problem or task, his mind should function according to a well-defined process in arriving at a decision as to the course to be followed. This process of reasoning is known as the estimate of the situation. This paragraph covers only estimates regarding engineer work and missions rather than tactical situations involving the engineer unit in combat, for which the form of estimate is given in FM 101-5. Whether written or unwritten, an estimate of the situation is a necessary mental process preliminary to every order issued toward the accomplishment of a mission.

b. The engineer of a higher echelon such as an army engineer may have great latitude in his decisions as compared to the engineer commander of a small unit such as a company whose functions are more canalized. If the engineer of a small unit is suddenly confronted with an emergency demanding immediate action there may be almost no time for deliberation, yet before he can reach an intelligent decision there must flash through his mind certain essential factors covering his mission, means available to him and to the enemy,

conditions in his area of operations, and best course of action to take. In such a case the process of reasoning may be very brief, but results in an intelligent approach rather than action based on chance. The unit engineer of a large force such as a division or larger unit may require, under some circumstances, days or even weeks for the most careful thought and study. He utilizes all of his staff; everything that may possibly affect the problem is considered, all probable contingencies are foreseen, and a decision may be reached only after the most exhaustive analysis. These examples illustrate the extremes, but the mental process involved in them is fundamentally the same, varying only in extent of detail.

c. In estimating a situation involving engineer operations as opposed to combat, the engineer often finds that the obstacles to be overcome are the restrictions imposed not only by the military situation but also and to a greater extent by natural laws and physical conditions. The strength, morale, and plans of the hostile forces concern the tactical commander, while the engineer is more concerned with such matters as congested communications, disintegrating roads, destroyed bridges, and the ever present problem of how to accomplish his mission with insufficient time, men, or transportation, and inadequate supplies of materials.

■ 296. DETAILS OF ESTIMATE OF SITUATION FOR SMALL UNIT.—In the simplest case where the engineer receives a definite mission, his estimate of the situation may follow the form given below:

a. *Mission*.—Brief statement of work to be accomplished.

b. *Obstacles to be overcome*.—(1) Limitation as to time.

(2) Special difficulties due to location such as great height of bridge, swift current, poor soil for foundation, probable rise or swollen condition of stream, etc.

(3) Difficulties likely to be encountered in getting tools and construction materials to site of work.

(4) Probable enemy interference with engineer work.

c. *Means available*.—(1) Transportation.

(2) Materials.

(3) Men.

(4) Equipment.

(5) Assistance in transportation, men, materials, or equipment which might reasonably be expected from engineers of other echelons or from other troops within his own unit.

(6) Other favorable factors.

d. Plans.—Various plans are considered for accomplishing the mission with a discussion of advantages and disadvantages of each. Under this heading should be considered in detail various types of construction applicable, sources of materials and other supply problems connected with each type, hours of work, time available, kind and amount of assistance which should be requested, etc. After a mental survey of possible plans for accomplishing the mission, it is well to follow this phase of the estimate of the situation with a brief general consideration of the problem to minimize possibility of overlooking important factors bearing thereon. The best plan is thus definitely determined.

e. Decision.—A brief general statement of how the work is to be accomplished, following the adopted plan.

■ 297. ESTIMATE OF SITUATION FOR DIVISION, CORPS, OR ARMY OPERATIONS.—In the more general case where the engineer is confronted with the mission of assisting the progress of his division or corps in an operation and he must employ his troops on numerous diversified lines of activity, the scope of the estimate of the situation necessarily becomes wider and it may take a form approximating the following:

a. Mission.—This usually is stated in the following form: "To assist the (attack) (withdrawal) (organization of position, etc.) of the (division) (corps) (army)."

b. Duties.—Statement of the work which it would be desirable to perform in furtherance of that mission. This work should be listed under headings corresponding to the duties of engineers as given in paragraph 2 so far as applicable to the situation. Under each heading should be stated briefly the quantity of work considered necessary, the approximate force required for its accomplishment, and any special difficulties connected therewith.

c. Means available.—(1) Transportation.

(2) Materials.

(3) Men.

(4) Equipment.

(5) Assistance in men, materials, or equipment which might reasonably be expected of other engineer echelons, assistance in transportation, manpower, or equipment from other troops that should be requested from the unit commander, and assistance which should be furnished to engineers of subordinate units.

(6) Other favorable factors.

d. Plans.—Feasible plans for distribution of forces over the various tasks, with a discussion of relative importance or announced priority of tasks and relative merit of the various plans, striking the correct balance between importance of the tasks and necessity for obtaining a commensurate return for the effort expended. This resolves itself into a consideration of tasks that must be eliminated, and of those on which the utmost effort must be expended for success of the operation.

e. Decision.—A general statement of how the duties are to be performed.

■ 298. ESTIMATE OF TERRAIN.—Unit engineers of all commands must be prepared at any time to furnish an estimate of the terrain to the unit commander. To do this he must keep himself informed of the tactical plans under way or proposed, and must require the necessary continuing reconnaissances for this purpose (see par. 292b). Whenever a new line of action is contemplated, a tactical study of the terrain involved is of paramount importance to the proper planning of the action. The unit engineer may be called upon for an oral or written terrain study, depending on the magnitude of the operation contemplated, and he should be prepared at all times to give an accurate, brief, and thoroughly prepared analysis.

■ 299. OUTLINE FOR TERRAIN APPRECIATION.—See FM 5-15 and 101-5. The purpose for which the study is made and applicable tactical considerations (for example, mission, apparent enemy capabilities, tentative own lines of action, or the commander's decision) must be kept in mind during this study as they limit the area of terrain and the tactical effects to be considered. The study may be mental, oral, or written, depending on circumstances, and will normally be made by

reference to the best map available. Graphical indication of a mission, lines of action, or an announced decision on the map of the area may be helpful. Inapplicable paragraphs or items and statements of fact already known to all concerned should be omitted from the outline given below:

a. Purpose and other limiting considerations.

b. General topography of the area.—(1) Drainage system.

(2) Ridge system.

(3) Routes of communication.

(4) General nature of terrain.

c. Military aspects of terrain.—Consider the terrain under discussion methodically by natural subareas; within each subarea, discuss (both from our own and from the enemy's standpoint as may be required by the purpose of the study) the effect on pertinent military action of such of the following terrain elements as are applicable:

(1) Avenues of approach and communications.

(2) Obstacles (natural and artificial).

(3) Concealment and cover.

(4) Observation.

(5) Fields of fire (all weapons).

d. Critical terrain features.—State any terrain features which, as a result of the foregoing study, appear to be critical or vital for either the enemy or our own troops (key features).

e. Tactical effect of terrain.—Summarize the effect of the terrain on such tactical or administrative operations or dispositions of either or both sides as may be appropriate. In case apparent enemy capabilities or tentative own lines of action, or both, are under consideration, use subheads for each such capability and line of action in turn.

■ 300. PLANS.—*a.* In order to carry his decision into effect it devolves upon the leader to formulate a plan that is more or less detailed, depending upon the nature of the problem. Thus the unit engineer, having arrived at a decision, plans in detail with the assistance of his staff the organization of the available troops and the allotment of the available materials, transportation, and equipment. Any properly prepared plan has certain important characteristics, namely, comprehensiveness, flexibility, and simplicity. The unit engineer's detailed plan of action in written form normally becomes the

engineer paragraphs or annex of the field or administrative order of the unit served, and the basis for other orders issued directly to the engineer troops.

b. The importance of anticipatory planning cannot be over-emphasized. From time to time the unit engineer or commander must prepare alternate plans for possible contingencies. When such a contingency develops, the previously prepared plan may be quickly adapted to new conditions and translated into orders.

■ **301 FIELD ORDERS.**—To be effective an order must carry the exact intentions of the commander and be received in time to permit it to be understood and executed correctly. A correct and uniform technique in issuance of orders saves time, reduces errors, and develops mutual understanding and confidence between commanders and subordinates. Orders must be couched in terms that cannot be misinterpreted. They should be adapted to the character, training, and experience of the troops. Within these limitations the order should be as brief as possible, the unit engineer deciding what can be omitted rather than leaving it to the subordinate commanders. Standard operating procedures to accomplish these purposes (see par. 304) are prescribed for engineer units. In all forms of orders references should be made to standard procedures whenever possible.

a. *Fragmentary.*—Fragmentary orders afford subordinates maximum time for their own reconnaissances, orders, and dispositions. They may be issued orally, dictated, or written, and whenever practicable should be accompanied by an operations map, overlay, or sketch. In larger units, officers are used for the delivery of oral fragmentary field orders whenever possible. When facilities and time permit, a field order issued initially in fragmentary form is usually confirmed by later issuance of the order in complete written form. It should reach subordinates as soon as possible if it is to be of any use during the operation; in any event it should be retained as a matter of record.

b. *Oral and dictated orders.*—Combat situations for engineers will usually require the use of spoken orders (oral or dictated). Such orders are brief without sacrificing clarity and carry the force inherent in the commander. Prepared

notes assist the commander to issue a good order, insure that the expected sequence is followed, and all necessary instructions are issued, and may be used as a basis for record (app. III). An operations map, overlay, or sketch issued with the order permits brevity and assists in accurate visualization of the situation, of the plan of the whole unit, and of the part each element plays. When field orders are issued orally or dictated, a written order should follow as soon as practicable. A good typist should furnish several copies at once for use of units most concerned.

(1) Oral orders are not written down by recipients verbatim but notes are taken. Their great advantage is the short time required for their issuance, but they have the disadvantage of depending upon the ear, and to some extent the memory of the receiver. The commander assembles the subordinates, says, "Take notes," orients them on the terrain or by map reference, issues his orders with force and clarity, and finishes by asking, "Any questions?"

(2) Dictated orders should always be used in preference to oral orders when time does not permit a complete written order, yet does permit use of this method. The receivers are required to take down verbatim all provisions of the order as given.

c. *Complete field order.*—The complete written field order has the advantages of accuracy, full information as to the part to be played by each element, lessened chance of misunderstanding, and coordination of all efforts. It attains its maximum value when it is issued sufficiently in advance to enable the recipients to act upon it prior to initiation of operations. For the details of this standard five-paragraph field order see FM 101-5 and engineer adaptations thereof in chapter 1, FM 5-35.

■ 302. PARAGRAPHS AND ANNEXES TO ORDERS.—a. *Engineer paragraphs of unit field order.*—(1) The tactical mission and disposition of the engineers appear in a subparagraph of *paragraph 3* of the field order of larger units. In the field order of the division this may cover attachment of engineers to tactical echelons, employment of engineers in organization of the ground, use of engineers as combat reserve, assignment to demolition missions, and use of engineers in

operations involving river crossings. The subparagraph is generally brief, except in the case of river crossings where the amount of detail may be considerable and even require amplification in the form of an annex (see *b* below).

(2) The major portions of the engineer mission are administrative matters that are appropriate for paragraph 4 of the field order. In divisions and larger units when the amount of engineer matter is very great, it is placed in the administrative order, and appears in the form of appropriate subparagraphs amplified if necessary by an annex (see *d* below).

(3) The unit engineer must operate the engineer arm of his unit and specific orders for him to do so are not necessary. The instructions appearing in the unit field order and its accompanying papers are primarily for the information of the command and staff, and are normally prepared by the unit engineer.

b. Engineer annexes to unit field order.—When tactical employment of engineers involves the statement of a plan in too great detail for inclusion in paragraph 3 of the unit field order, it may be necessary to include this in an annex to the unit field order as, for example, a detailed plan for tactical employment of engineers in a river crossing. This annex is given a number and an appropriate title; example: "Annex 5 to FO 10, Engineers." Such an annex is a directive that is followed in the operation, and that informs other commanders of the part taken by the engineers. The field order for the engineer arm or an appropriate extract therefrom may be used for this annex, or the annex may be only a statement of the essential features of the operating plan. It is prepared by the unit engineer and his staff.

c. Engineer paragraphs of unit administrative order.—In divisions and larger units, paragraph 4 of the field order usually consists of a reference to an administrative order. The unit engineer is concerned with those portions of the administrative order that cover engineer operations and normally prepares such portions.

d. Engineer annexes to unit administrative order.—The major portion of the engineer mission appears in the ad-

ministrative order of divisions and larger units in the form of a numbered annex entitled *Engineer Plan*. This annex is usually a brief statement of the engineer part in the operation in such detail as may be required to inform the major tactical units and the other arms and services of those features of the engineer plan necessary for the teamplay of the unit. It is prepared by the unit engineer.

■ 303. MISCELLANEOUS.—*a.* The unit engineer is concerned with preparation of such documents as are necessary to keep his troops informed of the engineer situation; for inclusion in reports of the unit commander; and for such special reports as may be required by the unit commander.

b. Engineer bulletins are the principal means of accomplishing these objectives. They may also be termed engineer situation reports, an example of which is given in paragraph 292. Much of the information may be expressed graphically by maps and charts. Such reports issued periodically, and specially when called for, are frequently referred to in or made annexes to the engineer field order.

c. In addition to these periodical bulletins, the unit engineer makes reports as required to the unit commander or his staff, and to the unit engineer of the next higher echelon.

■ 304. STANDARD OPERATING PROCEDURES.—*a.* In units a standard operating procedure may be prescribed by the unit commander to reduce the number and size of orders which would otherwise be required in combat operations and to establish definite routines habitually used and understood by all members of the command (FM 100-5). Flexibility is obtained by making necessary variations in standard procedures when required to meet unusual conditions or situations. The engineer provisions of procedures for larger units should be based on recommendations of the unit engineer; they should state such engineer duties (see pars. 49 to 55 and 258 to 273) as need be known to engineer and other division units to secure cooperation and coordination. Subordinate units adopt uniform operating procedures based on those of the higher units.

b. For an engineer unit a standard operating procedure includes necessary information regarding its operations as prescribed in the procedure of the higher unit; the proce-

cedure for a divisional engineer battalion or regiment amplifies pertinent data taken from the division procedure and adds material required by the unit for its own operations. A procedure for a special engineer unit conforms to instructions issued by the commander and unit engineer of the engineer service to which it is assigned. Engineer unit procedures cover, for all types of situation, such matters as—

(1) Designation of the units (usually a platoon to a company) to serve with each combat team.

(2) Formations, loadings, methods of operating vehicles in various movements (see par. 190 and FM 25-10) and of going into bivouac.

(3) Methods of securing and issuing supplies.

(4) Methods of issuing and action to be taken on warning orders and alerts.

(5) Special security measures and other combat instructions. All provisions of a standard operating procedure must be essential to saving time in giving and comprehending orders and to make routine operations clear; any provision that does not achieve these ends should be rescinded promptly.

APPENDIX I
REFERENCES

■ 1. WAR DEPARTMENT PUBLICATIONS.—*a. For training.*

- AR Army Regulations (especially Corps of Engineers series, AR 100-5 to 100-50, incl.).
- FSR Field Service Regulations (FM 100-5, 100-10, and 100-15).
- BFM Basic Field Manuals (FM 21-25, 21-26, 21-30, 21-35, 30-20, and 30-21 re maps; 21-5, 22-5, 23-5, 23-10, 23-25, 23-35, 24-5, 25-10, and 26-5).
- CFM Cavalry Field Manual (FM 2-5, 2-10, and 2-15).
- IFM Infantry Field Manual (FM 7-5).
- SOFM Staff Officers Field Manual (FM 101-5 and 101-10).
- T/O Tables of Organization.
- TM Technical Manuals (especially 5-230, 5-235, 5-245, and 5-270).
- MTP Mobilization Training Programs (MTP 5-1).
- AEC Army Extension Courses (especially that of the Engineer School).
- WDTD War Department Training Directive (issued annually).

b. For supply.

- AR Army Regulations, especially AR 775-10 for peacetime ammunition allowances.
- SNL Ordnance Standard Nomenclature List.
- T/BA 5 Tables of Basic Allowances (engineer).
- T/A Tables of Allowances.
- OQMG Circulars Nos. 1-18 and 4.
- ESC Corps of Engineers Supply Catalog, parts I and II.

c. Lists of current publications.

- List of Current Pamphlets and Changes, AR 1-10.
- List of Training Publications, FM 21-6 (FM's and TM's).

CORPS OF ENGINEERS

List of Tables of Organization.

List of Mobilization Regulations.

List of A. G. O. Blank Forms, AR 310-105.

Annual Announcement of Army Extension Courses.

d. *List of engineer Tables of Organization.*—The following is a list of the approved Tables of Organization for all engineer troop units now authorized:

GENERAL UNITS

T/O No.	Title
<i>Triangular Division</i>	
5-75.....	Engineer Battalion, Combat, Triangular Division.
5-76.....	Engineer Headquarters and Headquarters Company, Battalion, Combat, Triangular Division.
5-77.....	Engineer Company, Battalion, Combat, Triangular Division.
<i>Square Division</i>	
5-11.....	Engineer Regiment, Combat (Infantry Division, Square).
5-12.....	Engineer Headquarters and Headquarters and Service Company, Regiment, Combat (Infantry Division, Square).
5-15.....	Engineer Battalion, Regiment, Combat (Square Division).
5-17.....	Engineer Company, Regiment, Combat (Square Division).
<i>Cavalry</i>	
5-115.....	Engineer Squadron. ¹
5-116.....	Engineer Headquarters and Headquarters and Service Troop, Squadron.
<i>Armored Division</i>	
5-215.....	Engineer Battalion, Armored Division.
5-216.....	Engineer Headquarters and Headquarters Company, Battalion, Armored Division.
5-217.....	Engineer Company, Battalion, Armored Division.
5-218.....	Engineer Company, Bridge, Battalion, Armored Division.
<i>Corps</i>	
5-171.....	Engineer Regiment, Combat (Corps). ¹
5-172.....	Engineer Headquarters and Headquarters and Service Company, Combat (Corps).
5-175.....	Engineer Battalion, Regiment, Combat (Corps).

See footnote at end of table.

TROOPS AND OPERATIONS

GENERAL UNITS—continued

T/O No.	Title
<i>General Service</i>	
5-21.....	Engineer Regiment, General Service.
5-22.....	Engineer Headquarters and Headquarters and Service Company, Regiment, General Service.
5-25.....	Engineer Battalion, Regiment, General Service.
5-27.....	Engineer Company, General Service.
<i>Aviation</i>	
5-411.....	Engineer Regiment, Aviation. ¹
5-412.....	Engineer Headquarters, and Headquarters and Service Company, Regiment, Aviation.
5-416.....	Engineer Battalion Headquarters Company, Regiment, Aviation.
<i>Separate</i>	
5-35.....	Engineer Battalion, Separate.
5-36.....	Engineer Headquarters, and Headquarters and Service Company, Battalion, Separate.
5-37.....	Engineer Company, Battalion, Separate.

¹ For lettered company T/O, use T/O 5-77.

SPECIAL UNITS

T/O No.	Title
<i>Camouflage</i>	
5-95.....	Engineer Battalion, Camouflage, Army.
5-96.....	Engineer Headquarters and Headquarters and Service Company, Battalion, Camouflage, Army.
5-97.....	Engineer Company, Camouflage, Army.
5-135.....	Engineer Battalion, Camouflage, GHQ.
5-136.....	Engineer Headquarters and Headquarters and Service Company, Battalion, Camouflage, GHQ.
5-137.....	Engineer Company, Camouflage, GHQ.
5-138.....	Engineer Company, Shop, GHQ.
<i>Ponton</i>	
5-87.....	Engineer Company, Light Ponton.
5-275.....	Engineer Battalion, Heavy Ponton.
5-276.....	Engineer Headquarters and Headquarters and Service Company, Battalion, Heavy Ponton.
5-277.....	Engineer Company, Battalion, Heavy Ponton.

CORPS OF ENGINEERS

SPECIAL UNITS—continued

T/O No.	Title
<i>Railway</i>	
5-125.....	Engineer Battalion, Railway Operating.
5-126.....	Engineer Headquarters and Headquarters and Service Company, Battalion, Railway Operating.
5-127.....	Engineer Company, Maintenance of Way, Battalion, Railway Operating.
5-128.....	Engineer Company, Maintenance of Equipment, Battalion, Railway Operating.
5-129.....	Engineer Company, Transportation, Battalion, Railway Operating.
5-145.....	Engineer Battalion, Railway Shop.
5-146.....	Engineer Headquarters and Headquarters and Service Company, Battalion, Railway Shop.
5-147.....	Engineer Company, Erecting and Machine Shop, Battalion, Railway Shop.
5-148.....	Engineer Company, Boiler and Smith Shop, Battalion, Railway Shop.
5-149.....	Engineer Company, Car Repair, Battalion, Railway Shop.
<i>Topographic</i>	
5-167.....	Engineer Company, Topographic, Corps.
5-55.....	Engineer Battalion, Topographic (Army).
5-56.....	Engineer Headquarters and Headquarters and Service Company Battalion, Topographic (Army or GHQ).
5-57.....	Engineer Company, Reproduction (Army).
5-58.....	Engineer Company, Survey.
5-59.....	Engineer Company, Photomapping.
5-185.....	Engineer Battalion, Topographic (GHQ). ¹
5-187.....	Engineer Company, Reproduction (GHQ).
<i>Water Supply</i>	
5-65.....	Engineer Battalion, Water Supply.
5-66.....	Engineer Headquarters and Headquarters and Service Company, Battalion, Water Supply.
5-67.....	Engineer Company, Water Supply.
<i>Supply, Maintenance, and Transportation</i>	
5-47.....	Engineer Company, Depot.
5-157.....	Engineer Company, Mobile Shop.
5-88.....	Engineer Company, Dump Truck.

¹ Also includes companies as shown in T/O's 5-56, 5-58, and 5-59.

TROOPS AND OPERATIONS

HEADQUARTERS UNITS

T/O No.	Title
5-100-1.....	Engineer Headquarters, Corps.
5-200-1.....	Engineer Headquarters, Army
5-600-1.....	Engineer Headquarters, Communications Zone.
5-601-1.....	Engineer Headquarters, Communications Zone Section.
5-300-1.....	Engineer Headquarters, GHQ.
5-400-1.....	Engineer Headquarters, GHQ Air Force.
5-302.....	Engineer Headquarters, Railway.
5-602.....	Engineer Headquarters, Railway Grand Division.
5-603.....	Engineer Headquarters, Inland Waterways.

e. For mapping units.

AR 300-15, Maps and Mapping.

FM 5-5, section IV, chapter 11.

FM 30-20, Military Intelligence—Military Maps.

TM 5-230, Topographic Drafting.

TM 5-235, Surveying.

TM 5-236, Surveying Tables.

TM 2-245, Map Reproduction in the Field.

■ 2. OTHER PUBLICATIONS.—*a. Engineer reference library.*—

Issued to engineer units (see Engr. Sup. Cat., pt. I, and T/BA 5).

Title and author	Company set	Battalion or regimental set
American Electrician's Handbook, Croft.....	.....	1
Civil Engineer's Pocketbook, Trautwine.....	1	1
Handbook of Building Construction, Hool and Johnson:		
Vol. I.....	.....	1
Vol. II.....	.....	1
Highway Engineer's Handbook, Harger and Bonney.....	.....	1
Mechanical Engineers' Handbook, Marks.....	.....	1
Standard Construction Methods, Underwood.....	1	.....
Surveying, Johnson and Smith.....	.....	1

b. Conference course of Engineer School.—Series of eight problems (with notes) issued annually, covering employment of all types of engineer units in various situations used for instruction of engineer groups.

APPENDIX II

ABBREVIATED TABLES OF ORGANIZATION

The following abbreviated Tables of Organization show the total strength and major armament and equipment of each organization and its distribution to major subordinate elements.

TABLE I.—Assignment of engineer units to a type GHQ force of three armies

Unit designation	Number normally assigned to various tactical units ^a					Total in GHQ force
	Division	Corps	Army	GHQ Reserve	Air force	
Combat battalion (triangular division).....	♢ 1	-----	-----	-----	-----	9
Engineer squadron.....	♣ 1	-----	-----	-----	-----	-----
Engineer battalion (armored division).....	♠ 1	-----	-----	-----	-----	-----
Combat regiment (square division).....	♠ 1	-----	-----	-----	-----	18
Combat regiment (corps).....	-----	2	-----	-----	-----	18
General service regiment.....	-----	-----	3	10	-----	19
Separate battalion.....	-----	-----	6	30	-----	48
Camouflage battalion (Army).....	-----	-----	1	-----	-----	3
Camouflage battalion (GHQ).....	-----	-----	-----	1	-----	1
Heavy ponton battalion.....	-----	-----	2	8	-----	14
Topographic battalion (army).....	-----	-----	1	-----	-----	3
Topographic battalion (GHQ).....	-----	-----	-----	1	-----	1
Water-supply battalion.....	-----	-----	1	3	-----	6
Depot company.....	-----	-----	1	9	-----	12
Dump-truck company.....	-----	-----	2	18	-----	24
Light ponton company.....	-----	-----	4	12	-----	24
Topographic company (corps).....	-----	1	-----	-----	-----	9
Shop company.....	-----	-----	1	3	-----	6
Engineer headquarters (GHQ).....	-----	-----	-----	1	-----	1
Engineer headquarters (communications zone).....	-----	-----	-----	1	-----	1
Engineer headquarters (communications zone section).....	-----	-----	-----	3	-----	3
Engineer headquarters (army).....	-----	-----	1	-----	-----	3
Engineer headquarters (corps).....	-----	1	-----	-----	-----	9
Engineer headquarters (railway).....	-----	-----	-----	1	-----	1
Engineer headquarters (railway) grand division.....	-----	-----	-----	5	-----	5
Railway operating battalion.....	-----	-----	-----	15	-----	15
Railway shop battalion.....	-----	-----	-----	2	-----	2
Engineer headquarters (aviation).....	-----	-----	-----	-----	1	1
Engineer regiment (aviation).....	-----	-----	-----	-----	2	2

^a Does not include engineer units in subordinate tactical units.

♢ Per infantry division (triangular).

♣ Per cavalry division.

♠ Per armored division.

♠ Per infantry division (square).

NOTE.—This distribution is merely illustrative and is based on the normal needs of a type GHQ force consisting of a GHQ Air Force and three type armies of three type corps of one triangular and two square infantry divisions.

TABLE II.—*Platoon, combat battalion, triangular division*
(T/O 5-77)

		<i>Platoon headquarters</i>	
<i>Platoon</i>	Officers.....	1	
	Enlisted men.....	5	
	Motorcycle, solo.....	1	
	Trailer, 1-ton, cargo.....	1	
	Truck, 1½-ton, pick-up.....	1	
	Truck, 1½-ton, dump.....	1	
	Carpenter set.....	1	
	Demolition set.....	1	
	Pioneer set.....	1	
	Hammer, gas operat-		
	ed.....	1	
	Saw, timber.....	1	
	Machine gun, cal. .30.....	2	
	Pistol.....	3	
	Rifle.....	3	
		<i>Squad</i>	
		Sergeant.....	1
		Corporal.....	1
		Privates.....	11
		Truck, 1½-ton, dump.....	1
		Carpenter set.....	1
		Demolition set.....	1
		Pioneer set.....	1
		Pistol.....	1
		Rifle.....	12
		<i>Squad</i>	
		(Same as above.)	
		<i>Squad</i>	
		(Same as above.)	
		<i>Operating section</i>	
		Enlisted men.....	* 43
		Truck, 1½-ton, dump.....	3
		Pistol.....	3
		Rifle.....	40

* 4 privates are fillers and replacements.

**TABLE III.—Company, combat battalion, triangular division
(T/O 5-77)**

<i>Company (A, B, or C)</i>		<i>Company headquarters</i>	
Officers.....	4	Officers.....	1
Enlisted men.....	176	Enlisted men.....	* 32
Air compressor, motorized.....	1	Air compressor, motorized.....	1
Motorcycle, solo.....	3	Motorcycle, with side.....	1
Motorcycle, with side car.....	1	Tractor, with bulldozer and trailer.....	1
Tractor, with bulldozer and trailer.....	1	Trailer, 1-ton, cargo.....	1
Trailer, 1-ton, cargo.....	4	Truck, ½-ton, command.....	1
Truck, ½-ton, command.....	1	Truck, 1½-ton, dump.....	2
Truck, ½-ton, pick-up.....	3	Truck, 4-ton, cargo.....	1
Truck, 1½-ton, dump.....	14	Blacksmith set.....	1
Truck, 4-ton, cargo.....	1	Blacksmith set (Q).....	1
Machine gun, cal. .30.....	6	Carpenter and wheelwright set (Q).....	1
Pistol.....	30	Drafting and duplicating set.....	1
Rifle.....	150	Sign-painting set.....	1
		Sketching set.....	1
		Pistol.....	12
		Rifle.....	21
		<i>Platoon</i>	
		Officers.....	1
		Enlisted men.....	* 48
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, dump.....	4
		Tools. See table II.	
		Machine-gun, cal. .30.....	2
		Pistol.....	6
		Rifle.....	43
		<i>Platoon</i>	
		(Same as above.)	
		<i>Platoon</i>	
		(Same as above.)	

* 4 privates are fillers and replacements.

TABLE IV.—*Battalion headquarters and headquarters company, combat battalion, triangular division (T/O 5-76)*

		<i>Company headquarters</i>	
		Captain (S-4).....	1
		Lieutenant.....	1
		Enlisted men.....	^a 21
		Motorcycle with side car.....	1
		Truck, ½-ton, command.....	1
		Truck, 1½-ton, dump.....	1
		Pistol.....	11
		Rifle.....	12
		<i>Division engineer section</i>	
		Captain (assistant division engineer from battalion headquarters).....	(1)
		Enlisted men.....	^b 14
		Motorcycle, solo.....	1
		Truck, ½-ton, command.....	1
		Pistol.....	7
		Rifle.....	7
		<i>Administrative section</i>	
		Captain (adjutant from battalion headquarters).....	(1)
		Enlisted men.....	^b 10
		Truck, 1½-ton, dump.....	3
		Pistol.....	2
		Rifle.....	8
		<i>Supply section</i>	
		Captain (S-4 from company headquarters).....	(1)
		Enlisted men.....	^a 26
		Assault boats.....	10
		Trailer, 1-ton, cargo.....	11
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, dump.....	7
		Blacksmith set.....	1
<i>Battalion headquarters</i>			
Colonel (battalion commander and division engineer).....	1		
Major (executive).....	1		
Captains:			
Assistant division engineer..	1		
Adjutant (S-1).....	1		
Pistol.....	4		
<i>Headquarters company</i>			
Officers.....	2		
Enlisted men.....	88		
Assault boat.....	10		
Electric lighting set.....	1		
Motorcycle with side car.....	1		
Motorcycle, solo.....	1		
Power earth auger, motorized....	1		
Trailer, 1-ton, cargo.....	11		
Truck, ½-ton, command.....	2		
Truck, ½-ton, pick-up.....	1		

^a 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

Truck, 1½-ton, dump.....	11	Blacksmith set (Q).....	1
Truck, 2½-ton, cargo.....	1	Carpenter and wheelwright set....	1
Water-supply set.....	4	Drafting set.....	1
Intrenching set.....	3	Duplicating set.....	1
Pistol.....	24	Intrenching set.....	1
Rifle.....	66	Pipe-fitting set.....	1
		Sign-painting set.....	1
		Sketching set.....	1
		Supplementary set.....	1
		Surveying set.....	1
		Tinsmith set.....	1
		Water-supply set, including port- able purification unit.....	4
		Welding and cutting set.....	1
		Pistol.....	2
		Rifle.....	24
		<i>Motor section</i>	
		Enlisted men.....	* 17
		Electric light set.....	1
		Power earth auger, motorized.....	1
		Truck, 2½-ton-cargo.....	1
		Pistol.....	2
		Rifle.....	15

* 2 privates are fillers and replacements.

TABLE V.—*Engineer battalion, combat, triangular division*
(T/O 5-75)

<i>Combat battalion</i>		<i>Battalion headquarters and headquarters company</i>	
Officers.....	18	Officers.....	6
Enlisted men.....	616	Enlisted men.....	88
Air compressor, motorized.....	3	Assault boat.....	10
Assault boat.....	10	Electric lighting set.....	1
Electric lighting set.....	1	Motorcycle, with side car.....	1
Tractor, medium, with bulldozer and trailer.....	3	Motorcycle, solo.....	1
Motorcycle, with side car.....	4	Power earth auger, motorized.....	1
Motorcycle, solo.....	10	Trailer, 1-ton, cargo.....	11
Power earth auger, motorized.....	1	Truck, ½-ton, command.....	2
Trailer, 1-ton, cargo.....	23	Truck, ½-ton, pick-up.....	1
Truck, ½-ton, command.....	5	Truck, 1½-ton, dump.....	11
Truck, ½-ton, pick-up.....	10	Truck, 2½-ton, cargo.....	1
Truck, 1½-ton, dump.....	53	Water-supply set, including portable purification unit.....	4
Truck, 2½-ton, cargo.....	1	Pistol.....	28
Water-supply set.....	4	Rifle.....	66
Machine gun, cal. .30.....	18	<i>Company A</i>	
Pistol.....	118	Officers.....	4
Rifle.....	516	Enlisted men.....	176
		Air compressor, motorized.....	1
		Tractor, medium, with bulldozer and trailer.....	1
		Motorcycle, with side car.....	1
		Motorcycle, solo.....	3
		Trailer, 1-ton, cargo.....	4
		Truck, ½-ton, command.....	1
		Truck, ½-ton, pick-up.....	3
		Truck, 1½-ton, dump.....	14
		Truck, 4-ton, cargo.....	1
		Machine gun, cal. .30.....	6
		Pistol.....	30
		Rifle.....	150
		<i>Company B</i>	
		(Same as above.)	
		<i>Company C</i>	
		(Same as above.)	

TABLE VI.—*Lettered company, combat regiment, square division (T/O 5-17)*

<i>Company (A, B, C, D, E, or F)</i>		<i>Company headquarters</i>	
Officers.....	4	Captain (company commander).....	1
Enlisted men.....	123	Lieutenant.....	1
Air compressor, motorized.....	1	Enlisted men.....	* 27
Tractor, medium, with bulldozer and trailer.....	1	Air compressor, motorized.....	1
Motorcycle, with side car.....	1	Tractor, medium, with bulldozer and trailer.....	1
Motorcycle, solo.....	2	Motorcycle, with side car.....	1
Trailer, 1-ton, cargo.....	3	Trailer, 1-ton, cargo.....	1
Truck, ½-ton, command.....	1	Truck, ½-ton, command.....	1
Truck, ½-ton, pick-up.....	2	Truck, 1½-ton, dump.....	2
Truck, 1½-ton, dump.....	10	Truck, 4-ton, cargo.....	1
Truck, 4-ton, cargo.....	1	Blacksmith set.....	1
Machine gun, cal. .30.....	4	Blacksmith set (Q).....	1
Pistol.....	23	Carpenter and wheelwright set (Q).....	1
Rifle.....	104	Drafting and duplicating set.....	1
		Sign-painting set.....	1
		Sketching set.....	1
		Pistol.....	11
		Rifle.....	18
		<i>Platoon ^b</i>	
		Officers.....	1
		Enlisted men.....	* 48
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, dump.....	4
		Tools. See table II.	
		Machine gun, cal. .30.....	2
		Pistol.....	6
		Rifle.....	43
		<i>Platoon</i>	
		(Same as above.)	

* 3 privates are fillers and replacements.

^b Organization and equipment of the platoon of the combat regiment, square division, are identical to the platoon of the combat battalion, triangular division. See table II.

* 4 privates are fillers and replacements.

TABLE VII.—*Battalion, combat regiment, square division*
(T/O 5-15)

		<i>Battalion headquarters</i>	
		Major (battalion commander).....	1
		Captain.....	1
		Staff sergeant (battalion sergeant major).....	1
		Pistol.....	3
<i>Battalion</i>		<i>Company A (D)</i>	
Officers.....	14	Officers.....	4
Enlisted men.....	370	Enlisted men.....	*123
Air compressor, motorized.....	3	Air compressor, motorized.....	1
Tractor, medium, with bulldozer and trailer.....	3	Tractor, medium, with bulldozer and trailer.....	1
Motorecycle, with side car.....	3	Motorecycle, with side car.....	1
Motorecycle, solo.....	6	Motorecycle, solo.....	2
Trailer, 1-ton, cargo.....	9	Trailer, 1-ton, cargo.....	3
Truck, ½-ton, command.....	3	Truck, ½-ton, command.....	1
Truck, ½-ton, pick-up.....	6	Truck, ½-ton, pick-up.....	2
Truck, 1½-ton, dump.....	30	Truck, 1½-ton, dump.....	10
Truck, 4-ton, cargo.....	3	Truck, 4-ton, cargo.....	1
Machine gun, cal. .30.....	12	Machine gun, cal. .30.....	4
Pistol.....	72	Pistol.....	23
Rifle.....	312	Rifle.....	104
		<i>Company B (E)</i>	
		(Same as above.)	
		<i>Company C (F)</i>	
		(Same as above.)	

* 11 privates are fillers and replacements.

TABLE VIII.—Regimental headquarters and headquarters and service company, combat regiment, infantry square division (T/O 5-12)

<i>Regimental headquarters</i>	<i>Company headquarters</i>	<i>Division engineer and operations section</i>
Colonel (regimental commander and division engineer).....	Captain (company commander).....	Captains:
Lieutenant colonel (executive).....	Lieutenant (one assistant S-4).....	Assistant division engineer from regimental headquarters..... (1)
Captains:	Enlisted men.....	S-3 from regimental headquarters..... (1)
S-1.....	Pistol.....	Enlisted men..... ^b 9
S-2.....	Rifle.....	Pistol..... 5
S-3.....		Rifle..... 4
S-4.....		<i>Administrative section</i>
Assistant division engineer.....		Captain (adjutant (S-1) from regimental headquarters)..... (1)
Pistol.....		Enlisted men..... ^b 9
	<i>Headquarters platoon</i>	Pistol..... 2
	Enlisted men.....	Rifle..... 7
	Pistol.....	<i>Map section</i>
	Rifle.....	Captain (S-2 from regimental headquarters)..... (1)
<i>Headquarters and service company</i>		Enlisted men..... ^b 13
Officers.....		Pistol..... 6
Enlisted men.....		Rifle..... 7
Transportation and equipment. <i>See</i> equipment section.		<i>Supply section</i>
Pistol.....		Captain (S-4 from regimental headquarters)..... (1)
Rifle.....		Lieutenant (assistant S-4 from company headquarters)..... (1)
		Enlisted men..... ^b 7
		Pistol..... 4
		Rifle..... 3
		<i>Platoon headquarters</i>
		Lieutenant..... 1
		Enlisted men..... ^b 9
		Pistol..... 2
		Rifle..... 3
		<i>Equipment section</i>
		Enlisted men..... ^a 54
		Air compressor, motorized..... 1
		Assault boat..... 20

^a 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

^c 4 privates are fillers and replacements.

		Electric lighting set	1
		Power earth auger, motorized	1
		Tractor, medium, with bulldozer and trailer	1
		Trailer, map reproduction	1
		Car, 5-passenger sedan	1
		Motorcycle, solo	2
		Motorcycle, with side car	2
		Trailer, 1-ton, cargo	22
		Truck, $\frac{1}{2}$ -ton, command	5
		Truck, $\frac{1}{2}$ -ton, pickup	4
		Truck, $1\frac{1}{2}$ -ton, cargo	1
		Truck, $1\frac{1}{2}$ -ton, dump	17
		Truck, $1\frac{1}{2}$ -ton, tractor	1
		Truck, $2\frac{1}{2}$ -ton, cargo	2
		Truck, 4-ton, cargo	1
		B&W printing set	1
		Blacksmith set	1
		Blacksmith set (Q)	1
		Carpenter and wheelwright set (Q)	1
		Drafting set	1
		Duplicating set	1
		Intrenching set	6
		Pipe-fitting set	3
		Sign-painting set	1
		Sketching set	3
		Supplementary set	1
		Surveying set	1
		Tinsmith set	3
		Water supply set including portable purification unit	4
		Welding and cutting set	2
		Pistol	5
		Rifle	49
		<i>Repair section</i>	
		Enlisted men	*19
		Pistol	1
		Rifle	18
		<i>Service platoon</i>	
Officers	1		
Enlisted men	82		
Transportation and equipment. See equipment section.			
Pistol	8		
Rifle	75		

TABLE IX.—Engineer regiment, combat, infantry square division (T/O 5-11)

		<i>Regimental headquarters and band</i>	
		Officers.....	7
		Warrant officer.....	1
		Enlisted men.....	28
		Pistol.....	36
		<i>Headquarters and service company</i>	
		Officers.....	4
		Enlisted men.....	*140
		Air compressor, motorized.....	1
		Assault boat.....	20
		Electric lighting set.....	1
		Power earth auger, motorized.....	1
		Tractor, medium, with bulldozer and trailer.....	1
		Trailer, map reproduction.....	1
		Water supply set including portable purification unit.....	4
		Car, 5-passenger sedan.....	1
		Motorcycle, solo.....	2
		Motorcycle, with side car.....	2
		Trailer, 1-ton, cargo.....	22
		Truck, ½-ton, command.....	5
		Truck, ½-ton, pick-up.....	4
		Truck, 1½-ton, cargo.....	1
		Truck, 1½-ton, dump.....	17
		Truck, 1½-ton, tractor.....	1
		Truck, 2½-ton, cargo.....	2
		Truck, 4-ton, cargo.....	1
		Pistol.....	37
		Rifle.....	107
		<i>First battalion</i>	
		Officers.....	14
		Enlisted men.....	°370
		Air compressor, motorized.....	3
		Tractor, medium, with bulldozer and trailer.....	3
		Motorcycle, solo.....	6
		Motorcycle, with side car.....	3
		Trailer, 1-ton, cargo.....	9
		Truck, ½-ton, command.....	3
		Truck, ½-ton, pick-up.....	6
		Truck, 1½-ton, dump.....	30
		Truck, 4-ton, cargo.....	3
		Machine gun, cal. .30.....	12
		Pistol.....	72
		Rifle.....	312
		<i>Second battalion</i>	
		(Same as above.)	
<i>Combat regiment, infantry square division</i>			
Officers.....	39		
Warrant officer.....	1		
Enlisted men.....	908		
Air compressor, motorized.....	7		
Assault boat.....	20		
Electric lighting set.....	1		
Power earth auger, motorized.....	1		
Tractor, medium, with bulldozer and trailer.....	7		
Trailer, map reproduction.....	1		
Water supply set.....	4		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	14		
Motorcycle, with side car.....	8		
Trailer, 1-ton, cargo.....	40		
Truck, ½-ton command.....	11		
Truck, ½-ton, pick-up.....	16		
Truck, 1½-ton, cargo.....	1		
Truck, 1½-ton, dump.....	77		
Truck, 1½-ton, tractor.....	1		
Truck, 2½-ton, cargo.....	2		
Truck, 4-ton, cargo.....	7		
Machine gun, cal. .30.....	24		
Pistol.....	217		
Rifle.....	731		

* 13 privates are fillers and replacements.

° 33 privates are fillers and replacements.

TABLE X.—Squadron headquarters, and headquarters and service troop, squadron (T/O 5-116)

		<i>Troop headquarters</i>	
		Captain (S-4).....	1
		Lieutenant.....	1
		Enlisted men.....	• 21
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, command.....	2
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, dump.....	1
		Pistol.....	10
		Rifle.....	13
		<i>Division engineer section</i>	
		Captain (assistant division engineer from battalion headquarters).....	(1)
		Enlisted men.....	• 18
		B&W printing set.....	1
		Drafting set.....	1
		Duplicating set.....	1
		Electric lighting set.....	1
		Car, 5-passenger sedan.....	1
		Motorcycle, with side car.....	1
		Truck, ½-ton, command.....	1
		Truck, 1½-ton, dump.....	1
		Pistol.....	6
		Rifle.....	12
		<i>Administrative section</i>	
		Captain (adjutant from battalion headquarters).....	(1)
		Enlisted men.....	9
		Truck, 1½-ton, dump.....	3
		Pistol.....	3
		Rifle.....	6
		<i>Motor section</i>	
		Enlisted men.....	• 19
		Air compressor, motorized.....	1
		Power earth auger, motorized.....	1
		Tractor, medium, with bulldozer and trailer.....	1
		Truck, 2½-ton, cargo.....	1
		Truck, 4-ton, cargo.....	1
		Pistol.....	2
		Rifle.....	17
<i>Squadron headquarters</i>			
Lieutenant colonel (squadron commander and division engineer).....	1		
Major (executive).....	1		
Captain:			
S-1.....	1		
Assistant division engineer.....	1		
Pistol.....	4		
<i>Headquarters and service troop</i>			
Officers.....	2		
Enlisted men.....	89		
Air compressor, motorized.....	1		
Assault boat.....	10		
Electric lighting set.....	1		
Power earth auger, motorized.....	1		
Water supply set.....	3		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	1		
Motorcycle, with side car.....	1		
Tractor, medium, with bulldozer and trailer.....	1		
Trailer, 1-ton, cargo.....	12		
Truck, ½-ton, command.....	3		
Truck, ½-ton, pick-up.....	2		

• 2 privates are fillers and replacements.

Truck, 1½-ton, dump.....	12
Truck, 2½-ton, cargo.....	1
Truck, 4-ton, cargo.....	1
Pistol.....	23
Rifle.....	68

Supply section

Captain (S-4 from troop headquarters).....	(1)
Enlisted men.....	* 22
Assault boat.....	10
Trailer, 1-ton, cargo.....	11
Truck, ½-ton, pick-up.....	1
Truck, 1½-ton, dump.....	7
Blacksmith set.....	1
Blacksmith set (Q).....	1
Carpenter and wheelwright set (Q).....	1
Intrenching set.....	4
Pipe-fitting set.....	2
Sign-painting set.....	1
Sketching set.....	1
Supplementary set.....	1
Surveying set.....	1
Tinsmith set.....	3
Water supply set including portable purification unit.....	3
Welding and cutting set.....	1
Pistol.....	2
Rifle.....	20

TABLE XI.—*Engineer squadron (T/O 5-115)*

		<i>Squadron headquarters</i>	
		Officers.....	4
		Pistol.....	4
		<i>Headquarters and service troop</i>	
		Officers.....	2
		Enlisted men.....	89
		Air compressor, motorized.....	1
		Assault boat.....	10
		Electric lighting set.....	1
		Power earth auger, motorized.....	1
		Water supply set including portable purification unit.....	3
		Car, 5-passenger sedan.....	1
		Motorcycle, solo.....	1
		Motorcycle, with side car.....	1
		Tractor, medium, with bulldozer and trailer.....	1
		Trailer, 1-ton, cargo.....	12
		Truck, ½-ton, command.....	3
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, dump.....	12
		Truck, 2½-ton, cargo.....	1
		Truck, 4-ton, cargo.....	1
		Pistol.....	23
		Rifle.....	68
		<i>« Troop A</i>	
		Officers.....	4
		Enlisted men.....	176
		Air compressor, motorized.....	1
		Motorcycle, solo.....	3
		Motorcycle, with side car.....	1
		Tractor, medium, with bulldozer and trailer.....	1
		Trailer, 1-ton, cargo.....	4
		Truck, ½-ton, command.....	1
		Truck, ½-ton, pick-up.....	3
		Truck, 1½-ton, dump.....	14
		Truck, 4-ton, cargo.....	1
		Machine gun, cal. .30, light.....	6
		Pistol.....	30
		Rifle.....	150
		<i>Troop B</i>	
		(Same as above.)	
<i>Squadron</i>			
Officers.....	14		
Enlisted men.....	441		
Air compressor, motorized.....	3		
Assault boat.....	10		
Electric lighting set.....	1		
Power earth auger, motorized.....	1		
Water supply set.....	3		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	7		
Motorcycle, with side car.....	3		
Tractor, medium, with bulldozer and trailer.....	3		
Trailer, 1-ton, cargo.....	20		
Truck, ½-ton, command.....	5		
Truck, ½-ton, pick-up.....	8		
Truck, 1½-ton, dump.....	40		
Truck, 2½-ton, cargo.....	1		
Truck, 4-ton, cargo.....	3		
Machine gun, cal. .30, light.....	12		
Pistol.....	87		
Rifle.....	368		

« Organization and equipment of the troop and platoon of the engineer squadron are identical with the company and platoon of the combat battalion, triangular division. See tables II and III.

TABLE XII.—Engineer battalion, armored division
(T/O 5-215)

<i>Armored battalion</i>	
Officers.....	25
Enlisted men.....	^a 704
Car, 5-passenger sedan.....	1
Car, half-track with armament....	9
Car, scout, with armament.....	3
Carrier, personnel, half-track, with armament.....	38
Compressor, air, motorized.....	4
Motorcycle, solo.....	14
Earth auger, power, motorized....	1
Tractor, medium, with angle do- zer and trailer.....	3
Tricycle, motor.....	7
Truck, 2½-ton, cargo.....	48
Truck, 4-ton, cargo.....	3
Truck, ½-ton, command.....	17
Truck, crane.....	4
Truck, ½-ton, weapon carrier.....	9
Truck, 4-ton, tractor.....	41
Truck, 4-ton, wrecking.....	1
Boat, assault.....	20
Boat, power, utility.....	2
Bridge, steel, portable (H-10).....	1
Bridge, steel, portable (H-20).....	1
Bridge, ponton, heavy (250-foot)...	1
Bridge, portable, steel, trestle (300- foot).....	1
Crane, portable.....	4
Electric lighting set, 2-3 KV.-A....	4
Ferry, portable, 30-ton unit.....	2
Motor, outboard, 32-horsepower....	6.
Motor, outboard, 8-horsepower....	2
Semitrailer.....	41
Trailer, boat.....	2
Water supply set.....	4
Radio, two-way.....	8
Machine gun, light.....	31
Machine gun, cal. .50 (HB).....	17
Submachine gun.....	21
Pistol.....	310
Rifle.....	419
<i>Battalion headquarters</i>	
Officers.....	5
Pistol.....	5
<i>Headquarters company</i>	
Officers.....	4
Enlisted men.....	^b 146
(For equipment, see table XV.)	
<i>Company A</i>	
Officers.....	4
Enlisted men.....	^c 133
(For equipment, see table XIII.)	
<i>Company B</i>	
(Same as above.)	
<i>Company C</i>	
(Same as above.)	
<i>Bridge company</i>	
Officers.....	4
Enlisted men.....	^d 159
(For equipment, see table XIV.)	

^a 55 privates are fillers and replacements.

^b 10 privates are fillers and replacements.

^c 11 privates are fillers and replacements.

^d 12 privates are fillers and replacements.

TABLE XIII.—Engineer company, armored division
(T/O 5-217)

	<i>Company headquarters</i>		<i>Administrative section</i>	
<i>Engineer company, armored division</i>	Officers.....	2	Officers.....	1
	Enlisted men.....	^a 47	Enlisted men.....	^c 24
	Car, half-track with armament.....	2	Car, half-track, with armament.....	1
Officers.....	Carrier, personnel, half-track, with armament.....	1	Carrier, personnel, half-track, with armament.....	1
Enlisted men.....	Air compressor, motorized.....	1	Motorecycle, solo.....	2
Car, half-track with armament.....	Motorecycle, solo.....	2	Truck, 2½-ton, cargo.....	2
Carrier, personnel, half-track, with armament.....	Tricycle, motor.....	1	Truck, ½-ton, command.....	1
Air compressor, motorized.....	Truck, 2½-ton, cargo.....	5	Machine gun, light.....	2
Motorecycle, solo.....	Tractor, medium, with angle dozer and trailer.....	1	Submachine gun.....	2
Tricycle, motor.....	Truck, 4-ton, cargo.....	1	Pistol.....	16
Truck, 2½-ton, cargo.....	Truck, ½-ton, command.....	1	Rifle.....	9
Tractor, medium, with angle dozer and trailer.....	Truck, ½-ton, weapon carrier.....	1	<i>Reconnaissance section</i>	
Truck, 4-ton, cargo.....	Water supply set.....	1	Officers.....	1
Truck, ½-ton, command.....	Machine gun, light.....	3	Enlisted men.....	^d 4
Truck, ½-ton, weapon carrier.....	Machine gun, cal. .50 (HB).....	2	Car, half-track, with armament.....	1
Water supply set.....	Submachine gun.....	3	Pistol.....	4
Blacksmith set.....	Pistol.....	24	Rifle.....	1
Blacksmith set (Q).....	Rifle.....	25	<i>Equipment and transportation section</i>	
Carpenter set.....	<i>Platoon *</i>		Enlisted men.....	19
Carpenter and wheelwright set (Q).....	Officers.....	1	Air compressor, motorized.....	1
Demolition set.....	Enlisted men.....	^b 43	Tricycle, motor.....	1
Drafting and duplication set.....	Carrier, personnel, half-track, with armament.....	5	Truck, 2½-ton, cargo.....	3
Sign-painting set.....	Truck, ½-ton, command.....	1	Tractor, medium, with angle dozer and trailer.....	1
Sketching set.....	Carpenter set.....	1	Truck, 4-ton, cargo.....	1
Radio, two-way.....	Demolition set.....	1	Truck, ½-ton, weapon carrier.....	1
Machine gun, light.....	Pioneer set.....	1	Water supply set including portable purification unit.....	1
Machine gun, cal. .50 (HB).....	Hammer, gas operated.....	1	Machine gun, light.....	1
Submachine gun.....	Saw, timber.....	1	Machine gun, cal. .50 (HB).....	2
Pistol.....	Pistol.....	14	Submachine gun.....	1
Rifle.....	Rifle.....	30	Pistol.....	4
	<i>Platoon</i> (Same as above.)		Rifle.....	15

^a 3 privates are fillers and replacements. ^c 2 privates are fillers and replacements.

^b 4 privates are fillers and replacements. ^d 1 private is filler and replacement.

* Each squad has squad demolition, pioneer, and carpenter sets.

TABLE XIV.—*Bridge company, engineer battalion, armored division (T/O 5-218)*

		<i>Administrative section</i>	
		Officers.....	1
		Enlisted men.....	* 19
		Motorcycle, solo.....	2
		Tricycle, motor.....	1
		Truck, 2½-ton, cargo.....	2
		Truck, ½-ton, com- mand.....	1
		Machine gun, light.....	2
		Submachine gun.....	3
		Pistol.....	13
		Rifle.....	7
		<i>Maintenance section</i>	
		Officers.....	1
		Enlisted men.....	* 23
		Tricycle, motor.....	1
		Truck, 2½-ton, cargo.....	2
		Truck, ½-ton, com- mand.....	1
		Truck, ½-ton, weapon carrier.....	1
		Truck, 4-ton, wreck- ing.....	1
		Machine gun, cal. .50 (HB).....	1
		Machine gun, light.....	3
		Submachine gun.....	4
		Pistol.....	19
		Rifle.....	25
		Machine gun, cal. .50 (HB).....	1
		Machine gun, light.....	1
		Submachine gun.....	1
		Pistol.....	6
		Rifle.....	18
<i>Bridge company</i>		<i>Floating bridge platoon</i>	
Officers.....	4	Officers.....	1
Enlisted men.....	159	Enlisted men.....	* 66
Motorcycle, solo.....	4	Motorcycle, solo.....	1
Tricycle, motor.....	4	Tricycle, motor.....	1
Truck, 2½-ton, cargo.....	15	Truck, 2½-ton, cargo.....	5
Truck, ½-ton, com- mand.....	4	Truck, ½-ton, com- mand.....	1
Truck, ½-ton, weapon carrier.....	3	Truck, ½-ton, weapon carrier.....	1
Truck, 4-ton, tractor..	41	Truck, 4-ton, tractor..	24
Truck, 4-ton, wreck- ing.....	1	Boat, assault.....	20
Boat, assault.....	20	Boat, power, utility..	2
Boat, power, utility..	2	Bridge, ponton heavy (250-foot).....	1

* 3 privates are fillers and replacements.

* 4 privates are fillers and replacements.

* 1 private is a filler and replacement.

* 2 privates are fillers and replacements.

Bridge, ponton, heavy (250-foot).....	1	Crane, portable.....	2
Bridge, portable, steel (H-20).....	1	Ferry, portable, 30- ton.....	2
Bridge, portable, steel (H-10).....	1	Motor, outboard, 8- horsepower.....	2
Bridge, portable, steel trestle (300-foot)....	1	Motor, outboard, 32- horsepower.....	6
Crane, portable.....	4	Semitrailer.....	24
Ferry, portable, 30- ton.....	2	Trailer, boat.....	2
Outboard motor, 32- horsepower.....	6	Truck, crane.....	2
Outboard motor, 8- horsepower.....	2	Machine gun, cal. .50 (HB).....	2
Semitrailer.....	41	Machine gun, light....	3
Trailer, boat.....	2	Submachine gun.....	2
Truck, crane.....	4	Pistol.....	36
Radio, two-way.....	1	Rifle.....	31
Machine gun, cal. .50 (HB).....	5		
Machine gun, light....	10	<i>Fixed bridge platoon</i>	
Submachine gun.....	8	Officers.....	1
Pistol.....	84	Enlisted men.....	51
Rifle.....	79	Motorcycle, solo.....	1
		Tricycle, motor.....	1
		Truck, 2½-ton, cargo..	6
		Truck, ½-ton, com- mand.....	1
		Truck, ½-ton, weapon carrier.....	1
		Truck, 4-ton, tractor..	17
		Bridge, portable, steel (H-20).....	1
		Bridge, portable, steel (H-10).....	1
		Bridge, portable, steel, trestle (300-foot)....	1
		Crane, portable.....	2
		Semitrailer.....	17
		Truck, crane.....	2
		Machine gun, cal. .50 (HB).....	2
		Machine gun, light....	4
		Submachine gun.....	2
		Pistol.....	29
		Rifle.....	23

* 5 privates are fillers and replacements.

Truck, ½-ton, weapon carrier.....	3	<i>Reconnaissance platoon *</i>		<i>Administrative section</i>	
Water supply set.....	1	Officers.....	1	Captain (S-1).....	(1)
Blacksmith set.....	1	Enlisted men.....	^b 52	Enlisted men.....	6
Blacksmith set (Q).....	1	Car, scout, with armament.....	3	Truck, ½-ton, command.....	1
Drafting set.....	2	Carrier, personnel, half-track, with armament.....	5	Truck, ½-ton, weapon carrier.....	1
Duplicating set.....	1	Compressor, air, motorized.....	1	Pistol.....	4
Hammer, gas operated.....	1	Hammer, gas operated.....	1	Rifle.....	2
Pipe-fitting set.....	1			<i>Operations section</i>	
Saw, timber.....	1			Captain (S-3).....	(1)
Sign-painting set.....	1	Saw, timber.....	1	Enlisted men.....	^d 15
Supplementary set.....	1	Motorcycle, solo.....	1	Earth auger, power, motorized.....	1
Sketching set.....	1	Truck, ½-ton, command.....	1	Electric lighting set.....	4
Surveying set.....	1	Submachine gun.....	1	Truck, 2½-ton, cargo.....	2
Tinsmith set.....	1	Pistol.....	23	Water supply set, including portable purification unit.....	1
Welding and cutting set.....	1	Rifle.....	30	Machine gun, light.....	2
Carpenter and wheelwright set (Q).....	1			Pistol.....	4
Radio, two-way.....	4			Rifle.....	11
Machine gun, cal. .50 (HB).....	6			<i>Motor maintenance section</i>	
Machine gun, light.....	12			Officers.....	1
Submachine gun.....	4			Enlisted men.....	^d 12
Pistol.....	65			Truck, 2½-ton, cargo.....	1
Rifle.....	85			Truck, ½-ton weapon carrier.....	1
				Machine gun, light.....	1
				Pistol.....	3
				Rifle.....	10

^b 4 privates are fillers and replacements.

^d 1 private is filler and replacement.

* Each squad has squad carpenter, demolition, and pioneer sets.

TABLE XVI.—Battalion, combat regiment (corps) (T/O 5-175)

		<i>Battalion headquarters</i>	
		Major (battalion commander).....	1
		Captain.....	1
		Staff sergeant.....	1
		Pistol.....	3
<i>Battalion</i>		<i>Company A (D) *</i>	
Officers.....	14	Officers.....	4
Enlisted men.....	529	Enlisted men.....	^b 176
Air compressor, motorized.....	3	Air compressor, motorized.....	1
Tractor, medium, with bulldozer and trailer.....	3	Tractor, medium, with bulldozer and trailer.....	1
Motorcycle, with side car.....	3	Motorcycle, with side car.....	1
Motorcycle, solo.....	9	Motorcycle, solo.....	3
Trailer, 1-ton, cargo.....	12	Trailer, 1-ton, cargo.....	4
Truck, ½-ton, command.....	3	Truck, ½-ton, command.....	1
Truck, ½-ton, pick-up.....	9	Truck, ½-ton, pick-up.....	3
Truck, 1½-ton, dump.....	42	Truck, 1½-ton, dump.....	14
Truck, 4-ton, cargo.....	3	Truck, 4-ton, cargo.....	1
Machine gun, cal. .30.....	18	Machine gun, cal. .30.....	6
Pistol.....	93	Pistol.....	30
Rifle.....	450	Rifle.....	150
		<i>* Company B (E)</i>	
		(Same as above.)	
		<i>* Company C (D)</i>	
		(Same as above.)	

* Organization and equipment of the company and platoon of the combat regiment (corps) are identical to the company and platoon of the combat battalion, triangular division. See tables II and III.

^b 16 privates are fillers and replacements.

TABLE XVII.—Regimental headquarters and headquarters and service company, combat regiment (corps) (T/O 5-172)

	<i>Company headquarters</i>		<i>Camouflage section</i>	
	Captain (company commander).....	1	Lieutenant.....	1
	Lieutenant (one assistant S-4).....	2	Enlisted men.....	^b 9
	Enlisted men.....	^a 19	Pistol.....	4
	Pistol.....	11	Rifle.....	6
	Rifle.....	11	<i>Administrative section</i>	
			Captain (adjutant (S-1) from regimental headquarters).....	(1)
			Enlisted men.....	^b 11
			Pistol.....	4
			Rifle.....	7
	<i>Headquarters platoon</i>		<i>Operations section</i>	
<i>Regimental headquarters</i>	Officers.....	1	Captain (S-3 from regimental headquarters).....	(1)
Colonel (regimental commander).....	Enlisted men.....	43	Enlisted men.....	^b 10
Lieutenant colonel (executive).....	Pistol.....	19	Pistol.....	7
Captains:	Rifle.....	25	Rifle.....	3
S-1.....			<i>Supply section</i>	
S-2 and S-3.....			Captain (S-4 from regimental headquarters).....	(1)
S-4.....			Lieutenant (assistant S-4 from company headquarters).....	(1)
Pistol.....			Enlisted men.....	^b 13
			Pistol.....	4
			Rifle.....	9
			<i>Platoon headquarters</i>	
<i>Headquarters and service company</i>			Lieutenant.....	1
Officers.....		6	Enlisted men.....	^b 6
Enlisted men.....		142	Pistol.....	2
Transportation and equipment. <i>See</i> equipment section.			Rifle.....	5
Pistol.....		39	<i>Equipment section</i>	
Rifle.....		109	Lieutenant.....	1
			Enlisted men.....	^c 55
			Air compressor, motorized.....	2
			Assault boat.....	30
			Electric lighting set..	1
			Footbridge.....	1

^a 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

^c 5 privates are fillers and replacements.

		Power earth auger, motorized.....	1
		Power shovel, with trailer, $\frac{3}{8}$ -cubic-yard.....	1
		Power shovel, with trailer, $\frac{1}{2}$ -cubic-yard.....	1
		Road grader, motorized.....	1
		Tractor, medium, with bulldozer and trailer.....	2
		Water supply set including portable purification unit...	2
		Car, 5-passenger.....	1
		Motorcycle, with side car.....	2
		Motorcycle, solo.....	2
		Trailer, 1-ton, cargo...	18
		Truck, $\frac{1}{2}$ -ton, command.....	5
		Truck, $\frac{1}{2}$ -ton, pickup.....	4
		Truck, $1\frac{1}{2}$ -ton, dump...	17
		Truck, $2\frac{1}{2}$ -ton, cargo...	2
		Truck, 4-ton, cargo...	3
		Truck, $7\frac{1}{2}$ -ton, cargo...	1
		B & W printing set....	1
		Blacksmith set.....	1
		Blacksmith set (Q)...	1
		Carpenter and wheelwright set (Q).....	1
		Drafting set.....	1
		Duplicating set.....	1
		Intrenching set.....	2
		Pipe-fitting set.....	3
		Sign-painting set.....	1
		Sketching set.....	3
		Supplementary set...	1
		Surveying set.....	1
		Tinsmith set.....	3
		Welding and cutting set.....	2
		Pistol.....	6
		Rifle.....	50
		<i>Repair section</i>	
		Enlisted men.....	^b 19
		Pistol.....	1
		Rifle.....	18
	<i>Service platoon</i>		
Officers.....	2		
Enlisted men.....	80		
Transportation and equipment. <i>See</i> equipment section.			
Pistol.....	9		
Rifle.....	73		

^b 1 private is filler and replacement.

TABLE XVIII.—Engineer regiment, combat (corps)
(T/O 5-171)

Combat regiment (corps)

Officers.....	39
Warrant officer.....	1
Enlisted men.....	1, 228
Air compressor, motorized.....	8
Assault boat.....	30
Electric lighting set.....	1
Footbridge.....	1
Power earth auger, motorized.....	1
Power shovel, with trailer, $\frac{3}{4}$ -cubic-yard.....	1
Power shovel, with trailer, $\frac{1}{2}$ -cubic-yard.....	1
Road grader, motorized.....	1
Tractor, medium, with bull-dozer and trailer.....	8
Water supply set.....	2
Car, 5-passenger sedan.....	1
Motorcycle, with side car.....	8
Motorcycle, solo.....	20
Trailer, 1-ton, cargo.....	42
Truck, $\frac{1}{2}$ -ton, command.....	11
Truck, $\frac{1}{2}$ -ton, pick-up.....	22
Truck, $1\frac{1}{2}$ -ton, dump.....	101
Truck, $2\frac{1}{2}$ -ton, cargo.....	2
Truck, 4-ton, cargo.....	9
Truck, $7\frac{1}{2}$ -ton, cargo.....	1
Machine gun, cal. .30.....	36
Pistol.....	259
Rifle.....	1, 009

Regimental headquarters and band

Officers.....	5
Warrant officer.....	1
Enlisted men.....	28
Pistol.....	34

Headquarters and service company

Officers.....	6
Enlisted men.....	^a 142
Air compressor, motorized.....	2
Assault boat.....	30
Electric lighting set.....	1
Footbridge.....	1
Power earth auger, motorized.....	1
Power shovel, with trailer, $\frac{3}{4}$ -cubic-yard.....	1
Power shovel, with trailer, $\frac{1}{2}$ -cubic-yard.....	1
Road grader, motorized.....	1
Tractor, medium, with bull-dozer and trailer.....	2
Water supply set including portable purification unit.....	2
Car, 5-passenger sedan.....	1
Motorcycle, with side car.....	2
Motorcycle, solo.....	2
Trailer, 1-ton, cargo.....	18
Truck, $\frac{1}{2}$ -ton, command.....	5
Truck, $\frac{1}{2}$ -ton, pick-up.....	4
Truck, $1\frac{1}{2}$ -ton, dump.....	17
Truck, $2\frac{1}{2}$ -ton, cargo.....	2
Truck, 4-ton, cargo.....	3
Truck, $7\frac{1}{2}$ -ton, cargo.....	1
Pistol.....	39
Rifle.....	109

First battalion

Officers.....	14
Enlisted men.....	^b 529
Air compressor, motorized.....	3
Tractor, medium, with bull-dozer and trailer.....	3
Motorcycle, with side car.....	3
Motorcycle, solo.....	9
Trailer, 1-ton, cargo.....	12
Truck, $\frac{1}{2}$ -ton, command.....	3
Truck, $\frac{1}{2}$ -ton, pick-up.....	9
Truck, $1\frac{1}{2}$ -ton, dump.....	42
Truck, 4-ton, cargo.....	3
Machine gun, cal. .30.....	18
Pistol.....	93
Rifle.....	450

Second battalion

(Same as above.)

^a 13 privates are fillers and replacements.

^b 48 privates are fillers and replacements.

TABLE XIX.—*Company and platoon, general service regiment*
(T/O 5-27)

		<i>Company headquarters</i>	
		Captain (company commander).....	1
		Enlisted men.....	^a 40
		Air compressor, motorized.....	1
		Tractor, medium, with bulldozer and trailer.....	1
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, command.....	1
		Truck, 1½-ton, dump.....	2
		Truck, 4-ton, cargo.....	1
		Blacksmith set.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
		Drafting and duplicating set.....	1
		Sign-painting set.....	1
		Sketching set.....	1
		Machine gun, cal. .30.....	1
		Pistol.....	14
		Rifle.....	27
		<i>Platoon</i>	
		Officers.....	1
		Enlisted men.....	^a 45
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, dump.....	1
		Carpenter set.....	1
		Demolition set.....	1
		Pioneer set.....	1
		Pistol.....	5
		Rifle.....	41
		<i>Platoon</i>	
		(Same as above.)	
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		<i>Platoon</i>	
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		<i>Platoon</i>	
		(Same as above.)	

TABLE XX.—*Battalion, general service regiment (T/O 5-25)*

<i>Battalion</i>		<i>Battalion headquarters</i>	
Officers.....	14	Major (battalion commander).....	1
Enlisted men.....	526	Captain.....	1
Air compressor, motorized.....	3	Staff sergeant.....	1
Tractor, medium, with bulldozer and trailer.....	3	Pistol.....	3
Motorcycle, solo.....	3		
Trailer, 1-ton, cargo.....	12	<i>Company A (D)</i>	
Truck, ½-ton, command.....	3	Officers.....	4
Truck, ½-ton, pick-up.....	9	Enlisted men.....	*175
Truck, 1½-ton, dump.....	15	Air compressor, motorized.....	1
Truck, 4-ton, cargo.....	3	Tractor, medium, with bulldozer and trailer.....	1
Machine gun, cal. .30.....	3	Motorcycle, solo.....	1
Pistol.....	90	Trailer, 1-ton, cargo.....	4
Rifle.....	450	Truck, ½-ton, command.....	1
		Truck, ½-ton, pick-up.....	3
		Truck, 1½-ton, dump.....	6
		Truck, 4-ton, cargo.....	1
		Machine gun, cal. .30.....	1
		Pistol.....	29
		Rifle.....	150
		<i>Company B (E)</i>	
		(Same as above.)	
		<i>Company C (D)</i>	
		(Same as above.)	

* 16 privates are fillers and replacements.

TABLE XXI.—Regimental headquarters and headquarters and service company, general service regiment (T/O 5-22)

		<i>Administrative section</i>	
		Captain (adjutant (S-1) from regimental headquarters).....	(1)
		Enlisted men.....	^b 10
		Pistol.....	3
		Rifle.....	7
		<i>Company headquarters</i>	
		Captain (company commander).....	1
		Lieutenant (assistant S-4's).....	2
		Enlisted men.....	^a 18
		Pistol.....	11
		Rifle.....	10
		<i>Headquarters platoon</i>	
		Officers.....	1
		Enlisted men.....	58
		Pistol.....	20
		Rifle.....	39
<i>Regimental headquarters</i>		<i>Operations and planning section</i>	
Colonel (regimental commander).....	1	Captain (S-2 and S-3 from regimental headquarters).....	(1)
Lieutenant colonel (executive).....	1	Lieutenant (assistant and camouflage officer).....	1
Captains:		Enlisted men.....	^a 30
S-1.....	1	Pistol.....	10
S-2 and S-3.....	1	Rifle.....	21
S-4.....	1	<i>Engineer section</i>	
Pistol.....	5	Enlisted men.....	^b 5
		Pistol.....	3
		Rifle.....	2
		<i>Supply section</i>	
		Captains (S-4 from regimental headquarters).....	(1)
		Enlisted men.....	^b 13
		Pistol.....	4
		Rifle.....	9
		<i>Platoon headquarters</i>	
		Lieutenant (one platoon commander).....	2
		Enlisted men.....	^b 4
		Pistol.....	3
		Rifle.....	3
		<i>Transportation section</i>	
		Enlisted men.....	^c 45
		Air compressor, motorized.....	2
		Electric lighting set.....	1
		Road grader, motorized.....	2
		Power earth auger, motorized.....	1
<i>Headquarters and service company</i>			
Officers.....	6		
Enlisted men.....	141		
Transportation and equipment. See transportation section.			
Pistol.....	39		
Rifle.....	108		

^a 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

^c 3 privates are fillers and replacements.

		Shovel, power, with trailer, $\frac{1}{2}$ -cubic yard.	2
		Tractor, medium, with bulldozer and trailer.	2
		Car, 5-passenger sedan.	1
		Motorcycle, with side car.	2
		Motorcycle, solo.	2
		Trailer, 1-ton, cargo.	7
		Truck, $\frac{1}{2}$ -ton, command.	3
		Truck, $\frac{1}{2}$ -ton, pickup.	4
		Truck, $1\frac{1}{2}$ -ton, dump.	11
		Truck, $2\frac{1}{2}$ -ton, cargo.	2
		Truck, 4-ton, cargo.	2
		Truck, $7\frac{1}{2}$ -ton, cargo.	2
		B&W printing set.	1
		Blacksmith set.	1
		Blacksmith set (Q).	1
		Carpenter and wheelwright set (Q).	1
		Drafting set.	1
		Duplicating set.	1
		Hammer (gas-operated).	2
		Pipe-fitting set.	3
		Sign-Painting set.	1
		Sketching set.	3
		Supplementary set.	1
		Surveying set.	1
		Tinsmith set.	3
		Water supply set, including portable purification unit.	2
		Welding and cutting set.	2
		Pistol.	4
		Rifle.	41
		<i>Repair section</i>	
		Enlisted men.	^a 16
		Pistol.	1
		Rifle.	15
		<i>Service platoon</i>	
		Officers.	2
		Enlisted men.	65
		Transportation and equipment. See transportation section.	
		Pistol.	8
		Rifle.	59

^a 2 privates are fillers and replacements.

TABLE XXII.—*Engineer regiment, general service (T/O 5-21)*

<i>General service regiment</i>		<i>Regimental headquarters and band</i>	
Officers.....	39	Officers.....	5
Warrant officer.....	1	Warrant officer.....	1
Enlisted men.....	1, 221	Enlisted men.....	28
Air compressor, motorized.....	8	Pistol.....	34
Electric lighting set.....	1		
Road grader, motorized.....	2	<i>Headquarters and service company</i>	
Power earth auger, motorized.....	1	Officers.....	6
Shovel, power, with trailer, ½-cubic yard.....	2	Enlisted men.....	141
Tractor, medium, with bulldozer and trailer.....	8	Air compressor, motorized.....	2
Water supply set.....	2	Electric lighting set.....	1
Car, 5-passenger sedan.....	1	Road grader, motorized.....	2
Motorcycle, with side car.....	2	Power earth auger, motorized.....	1
Motorcycle, solo.....	8	Shovel, power, with trailer, ½-cubic yard.....	2
Trailer, 1-ton, cargo.....	31	Tractor, medium, with bulldozer and trailer.....	2
Truck, ½-ton, command.....	9	Water supply set, including portable purification unit.....	2
Truck, ½-ton, pick-up.....	22	Car, 5-passenger sedan.....	1
Truck, 1½-ton, dump.....	41	Motorcycle, with side car.....	2
Truck, 2½-ton, cargo.....	2	Motorcycle, solo.....	2
Truck, 4-ton, cargo.....	8	Trailer, 1-ton, cargo.....	7
Truck, 7½-ton, cargo.....	2	Truck, ½-ton, command.....	3
Machine gun, cal. .30.....	6	Truck, ½-ton, pick-up.....	4
Pistol.....	253	Truck, 1½-ton, dump.....	11
Rifle.....	1, 008	Truck, 2½-ton, cargo.....	2
		Truck, 4-ton, cargo.....	2
		Truck, 7½-ton, cargo.....	2
		Pistol.....	39
		Rifle.....	108
		<i>First battalion</i>	
		Officers.....	14
		Enlisted men.....	526
		Air compressor, motorized.....	3
		Tractor, medium, with bulldozer and trailer.....	3
		Motorcycle, solo.....	3
		Trailer, 1-ton, cargo.....	12
		Truck, ½-ton, command.....	3
		Truck, ½-ton, pick-up.....	9
		Truck, 1½-ton, dump.....	15
		Truck, 4-ton, cargo.....	3
		Machine gun, cal. .30.....	3
		Pistol.....	90
		Rifle.....	450
		<i>Second battalion</i>	
		(Same as above.)	

^a 13 privates are fillers and replacements.

^b 48 privates are fillers and replacements.

TABLE XXIII.—*Engineer regiment, aviation (T/O 5-411)**Engineer regiment,
aviation*

Officers.....	66		
Warrant officer.....	1		
Enlisted men.....	2160		
Air compressor, motorized.....	11		
Power earth auger.....	1		
Camera, copying, motorized.....	1		
Clearing unit.....	1		
Electric lighting set.....	4		
Emulsion distributor.....	1		
Equipment welder, electric arc and oxy-acetylene.....	3		
Grader, road, leaning wheel.....	3		
Grader road, motorized.....	9		
Map reproduction unit, motorized.....	1		
Mixer, road material.....	1		
Plow, disk, heavy.....	11		
Plow, tractor.....	9		
Roller, rubber tired.....	1		
Roller, sheepsfoot, triple.....	4		
Roller, smooth, 10-ton.....	1		
Roller, smooth, 5-ton, tandem.....	1		
Rooter, heavy.....	3		
Rooter, medium.....	3		
Scraper, wheeled, 8-yard.....	9		
Scraper, wheeled, 12-yard.....	3		
Shovel, power, with trailer, ½ yard.....	3		
Shovel, power, with trailer, ¾-yard.....	1		
Tank, storage, 500-gallon, portable trailer type.....	9		
Tank, storage, 1,000-gallon, portable trailer type.....	1		
		<i>Regimental headquarters and band</i>	
Officers.....	7		
Warrant officer.....	1		
Enlisted men.....	28		
Pistol.....	36		
		<i>Regimental headquarters and band</i>	
Colonel (regimental commander).....	1		
Lieutenant colonel (executive).....	1		
Captains:			
Adjutant.....	1		
Engineering.....	1		
Supply.....	1		
1st Lieutenants:			
Topographic officer.....	1		
Camouflage officer.....	1		
		<i>Band</i>	
Warrant officer.....	1		
Enlisted men.....	28		
		<i>Headquarters and service company</i>	
Officers.....	5		
Enlisted men.....	* 224		
		(For equipment, see table XXV.)	
		<i>Battalion headquarters and headquarters company</i>	
Officers.....	6		
Enlisted men.....	* 108		
		(For equipment, see table XXIV.)	

* 20 privates are fillers and replacements.

* 10 privates are fillers and replacements.

		<i>Battalion</i>	<i>Company</i>
Tractor, diesel, 70-horsepower.....	9	Officers.....	4
Tractor, diesel, 95-horsepower.....	3	Enlisted men..... ^b 637	Enlisted men..... ^c 176
Tractor, rubber tired..	1	(For equipment, see table XXIV.)	(For equipment, see table XXIV.)
Trailer, 8-ton.....	10		
Trailer, 15-ton.....	11		<i>Company</i>
Trailer, 21-ton.....	1		(Same as above.)
Trencher, vertical boom.....	1		<i>Company</i>
Truck, semitrailer....	1		(Same as above.)
Water supply set.....	3		
Car, 5 - passenger sedan.....	4		
Motorcycle, with side car.....	14	<i>Battalion</i>	
Motorcycle, solo.....	27	(Same as above.)	
Trailer, 1-ton, cargo..	55	<i>Battalion</i>	
Truck, ½-ton, command.....	16	(Same as above.)	
Truck, ½-ton, radio... 5			
Truck, ½-ton, pickup.....	48		
Truck, 1½-ton, dump..	161		
Truck, 2½-ton, cargo..	6		
Truck, 4-ton, cargo... 42			
Truck, 7½-ton, cargo..	16		
Truck, 1½-ton, tractor.....	2		
Tractor, medium, with bull-dozer and trailer.....	17		
Mixer, concrete, 14-cubic-foot, trailer mounted.....	3		
Tractor, crane, 30-foot boom.....	3		
Radio, two-way.....	5		
Pistol.....	492		
Rifle.....	1,735		

^b 58 privates are fillers and replacements.

^c 16 privates are fillers and replacements.

TABLE XXIV.—Battalion, battalion headquarters company, and company, engineer regiment, aviation (T/O 5-411 and T/O 5-416)

		<i>Battalion headquarters</i>	
		Officers	3
		Pistol	3
		<i>Battalion headquarters company</i>	
		Officers	3
		Enlisted men	108
		Blacksmith set	1
		Blacksmith set (Q)	1
		Carpenter and wheelwright set (Q)	1
		Supplementary set	1
		Electric lighting set	1
		Equipment welder, electric arc and oxy-acetylene	1
		Grader, road, leaning wheel	1
		Grader, road, motorized	3
		Mixer, concrete, 14-cubic-foot, mounted	1
		Rooter, heavy	1
		Rooter, medium	1
		Roller, sheepsfoot, triple	1
		Scraper, wheeled, 8-yard	3
		Shovel, power, with trailer, ½-yard	1
		Tractor, diesel, 70-horsepower	3
		Tractor, crane, 30-foot boom	1
		Trailer, 8-ton	2
		Trailer, 15-ton	3
		Water supply set, including portable purification unit	1
		Welding and cutting set	1
		Car, 5-passenger sedan	1
		Motorecycle, with side car	1
		Trailer, 1-ton, cargo	6
		Truck, ½-ton, command	1
<i>Battalion</i>		<i>Company headquarters</i>	
Officers	18	Officers	2
Enlisted men	636	Enlisted men	*17
Blacksmith set	1	Pistol	7
Blacksmith set (Q)	1	Rifle	12
Carpenter and wheelwright set (Q)	1	<i>Headquarters platoon</i>	
Supplementary set	1	Enlisted men	^b 20
Air compressor, motorized	3	Pistol	10
Electric lighting set	1	Rifle	10
Equipment welder, electric arc and oxy-acetylene	1	<i>Service platoon</i>	
Grader, road, leaning wheel	1	Officers	1
Grader, road, motorized	3	Enlisted men	*71
Plow, disk, heavy	3	Pistol	8
Plow, tractor	3	Rifle	64
Roller, sheepsfoot, triple	1	(With exception of rifles and pistols, the service platoon is assigned all organic equipment of the company.)	
Rooter, heavy	1	<i>Company headquarters</i>	
Rooter, medium	1	Officers	1
Scraper, wheeled, 8-yard	3	Enlisted men	32
Shovel, power, with trailer, ½-yard	1	Air compressor, motorized	1
Tank, storage, 500-gallon, portable trailer type	3	Plow, disk, heavy	1
Tractor, diesel, 70-horsepower	3	Plow, tractor	1
		Tank, storage, 500-gallon, portable trailer	1

* 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

* 7 privates are fillers and replacements.

Trailer, 8-ton.....	2	Truck, ½-ton, radio..	1	Tractor, with bull-	
Trailer, 15-ton.....	3	Truck, ½-ton, pick-		dozer and trailer...	1
Water supply set, in-		up.....	3	Trailer, 1-ton, cargo..	1
cluding portable		Truck, 1½-ton, dump..	7	Truck, ½-ton, com-	
purification unit....	1	Truck, 2½-ton, cargo..	1	mand.....	1
Welding and cutting		Truck, 4-ton, cargo....	8	Truck, 1½-ton, dump..	2
set.....	1	Truck, 7½-ton, cargo..	4	Truck, 4-ton, cargo....	1
Car, 5-passenger se-		Tractor, medium,		Pistol.....	12
dan.....	1	with bulldozer and		Rifle.....	21
Motorcycle, with side		trailer.....	2		
car.....	4	Radio, two-way.....	1	<i>Platoon</i> ^d	
Motorcycle, solo.....	9	Pistol.....	25	Officers.....	1
Trailer, 1-ton, cargo..	18	Rifle.....	86	Enlisted men.....	48
Truck, ½-ton, com-		<i>Company</i>		Motorcycle, solo.....	1
mand.....	4	Officers.....	4	Trailer, 1-ton, cargo..	1
Truck, ½-ton, radio..	1	Enlisted men.....	176	Truck, ½-ton, pick-	
Truck, ½-ton, pick-		Air compressor,		up.....	1
up.....	12	motorized.....	1	Truck, 1½-ton, dump..	4
Truck, 1½-ton, dump..	49	Plow, disk, heavy....	1	Carpenter set.....	1
Truck, 2½-ton, cargo..	1	Plow, tractor.....	1	Demolition set.....	1
Truck, 4-ton, cargo....	11	Tank, storage, 500-		Pioneer set.....	1
Truck, 7½-ton, cargo..	4	gallon, portable		Hammer, gas - oper-	
Tractor, medium with		trailer.....	1	ated.....	1
bulldozer and trail-		Motorcycle, with side		Saw, timber.....	1
er.....	5	car.....	1	Pistol.....	6
Mixer, concrete, 14-		Motorcycle, solo.....	3	Rifle.....	43
cubic-foot, trailer		Trailer, 1-ton, cargo..	4		
mounted.....	1	Truck, ½-ton, com-		<i>Platoon</i>	
Tractor, crane, 30-		mand.....	1	(Same as above.)	
foot boom.....	1	Truck, ½-ton, pick-			
Radio, two-way.....	1	up.....	3	<i>Platoon</i>	
Pistol.....	133	Truck, 1½-ton, dump..	14	(Same as above.)	
Rifle.....	521	Truck, 4-ton, cargo..	1		
		Tractor, medium,			
		with bulldozer and			
		trailer.....	1		
		Blacksmith set.....	1		
		Blacksmith set (Q)...	1		
		Drafting and duplicat-			
		ing set.....	1		
		Sign-painting set....	1		
		Sketching set.....	1		
		Carpenter and wheel-			
		wright set (Q).....	1		
		Pistol.....	35		
		Rifle.....	145		
		<i>Company</i>			
		(Same as above.)			
		<i>Company</i>			
		(Same as above.)			

^d Each squad has squad carpenter, demolition, and pioneer sets.

TABLE XXV.—*Engineer headquarters and headquarters and service company, regiment, aviation (T/O 5-412)*

		<i>Company headquarters</i>			
		Officers.....	3		
		Enlisted men.....	* 26		
		Pistol.....	8		
		Rifle.....	21		
				<i>Administrative section</i>	
				Captain (adjutant from regimental headquarters).....	1
				Enlisted men.....	13
				Pistol.....	3
				Rifle.....	10
				<i>Topographic section</i>	
				Lieutenant (from regimental headquarters).....	1
				Enlisted men.....	21
				Pistol.....	11
				Rifle.....	10
		<i>Headquarters platoon</i>			
		Enlisted men.....	50		
		Pistol.....	22		
		Rifle.....	28		
				<i>Engineering section</i>	
				Captain (from regimental headquarters).....	1
				Enlisted men.....	6
				Pistol.....	4
				Rifle.....	2
				<i>Camouflage section</i>	
				Lieutenant (from regimental headquarters).....	1
				Enlisted men.....	10
				Pistol.....	4
				Rifle.....	6
				<i>Regimental supply section</i>	
				Captain (supply officer from regimental headquarters).....	1
				Lieutenant (assistant supply officer from regimental headquarters).....	1
				Enlisted men.....	* 9
				Pistol.....	2
<i>Headquarters and service company</i>					
Officers.....	5				
Enlisted men.....	224				
Air compressor, motorized.....	2				
Power earth auger.....	1				
Camera, copying, motorized.....	1				
Clearing unit.....	1				
Electric lighting set..	1				
Emulsion distributor..	1				
Mixer, road material..	1				
Plow, disk, heavy.....	2				
Roller, rubber tired..	1				
Roller, sheepfoot, triple.....	1				
Roller, smooth, 10-ton.....	1				
Roller, smooth, 5-ton, tandem.....	1				
Scraper, wheeled, 12-yard.....	3				
Shovel, power, with trailer, ¾-yard.....	1				
Tank, storage, 1,000-gallon, portable trailer.....	1				

* 6 privates are fillers and replacements.

* 1 private is filler and replacement.

Tractor, diesel, 95 horsepower.....	3
Tractor, rubber tired..	1
Trailer, 8-ton.....	4
Trailer, 15-ton.....	2
Trailer, 21-ton.....	1
Trailer, map reproduction.....	2
Trencher, vertical boom.....	1
Truck, semitrailer....	1
Car, 5-passenger sedan..	1
Motorcycle, with side car.....	2
Trailer, 1-ton, cargo..	1
Truck, ½-ton, command.....	4
Truck, ½-ton radio..	2
Truck, ½-ton, pick-up.....	6
Truck, 1½-ton, dump..	14
Truck, 2½-ton, cargo..	3
Truck, 4-ton, cargo....	9
Truck, 7½-ton, cargo..	4
Tractor, medium, with bulldozer and trailer.....	2
Blacksmith set.....	1
Blacksmith set (Q)....	1
Drafting set.....	1
Duplicating set.....	1
Hammer (gas-operated).....	1
Map, reproduction equipment (motorized).....	1
Pipe-fitting set.....	3
Sign-painting set.....	1
Sketching set.....	3
Surveying set.....	1
Tinsmith set.....	3
Carpenter and wheelwright set (Q).....	1
Radio, two-way.....	2
Pistol.....	57
Rifle.....	172

Supply platoon

Enlisted men.....	42
Pistol.....	17
Rifle.....	25

Rifle.....	7
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Air force engineer depot section

Enlisted men.....	9
Truck, ½-ton, pick-up.....	1
Pistol.....	4
Rifle.....	5

Refilling point section

Enlisted men.....	18
Truck, ½-ton, pick-up.....	4
Pistol.....	8
Rifle.....	10

Air depot section

Enlisted men.....	6
Truck, ½-ton, pick-up.....	1
Pistol.....	3
Rifle.....	3

Platoon headquarters

Officers.....	1
Enlisted men.....	4
Pistol.....	3
Rifle.....	2

Transportation section

Officers.....	1
Enlisted men.....	62
Tank, storage, 1,000-gallon, portable....	1
Trailer, 8-ton.....	4
Trailer, 15-ton.....	2
Trailer, 21-ton.....	1
Trailer, map reproduction.....	2
Truck, semitrailer....	1
Car, 5-passenger sedan.....	1
Motorcycle, with side car.....	2
Trailer, 1-ton, cargo..	1

4 privates are fillers and replacements.

10 privates are fillers and replacements.

2 privates are fillers and replacements.

TABLE XXV.—Engineer headquarters and headquarters and service company, regiment, aviation (T/O 5-412)—Con.

		Truck, ½-ton, command.....	6
		Truck, ½-ton, pickup.....	6
		Truck, 1½-ton, dump.....	14
		Truck, 2½-ton, cargo.....	3
		Truck, 4-ton, cargo.....	9
		Truck, 7½-ton, cargo.....	14
		Truck, 1½-ton, tractor.....	2
		Pistol.....	3
		Rifle.....	60
	<i>Service platoon</i>		
Officers.....	2		
Enlisted men.....	^c 106	<i>Equipment section</i>	
Pistol.....	10	Enlisted men.....	^f 29
Rifle.....	98	Air compressor, motorized.....	2
		Clearing unit.....	1
		Emulsion distributor.....	1
		Mixer, road material.....	1
		Plow, disk, heavy.....	2
		Power earth auger, motorized.....	1
		Roller, rubber tired.....	1
		Roller, smooth, 10-ton.....	1
		Roller, smooth, 5-ton, tandem.....	1
		Scraper, carry-all, 12-yard.....	3
		Shovel, power, with trailer, ¾-yard.....	1
		Tractor, diesel, 95-horsepower.....	3
		Tractor, rubber tired.....	1
		Trencher, vertical boom.....	1
		Tractor, medium, with bulldozer and trailer.....	2
		Pistol.....	1
		Rifle.....	28
		<i>Repair section</i>	
		Enlisted men.....	^d 11
		Pistol.....	3
		Rifle.....	8

^c 10 privates are fillers and replacements.

^d 1 private is filler and replacement.

^f 3 privates are fillers and replacements.

TABLE XXVI.—*Platoon, separate battalion (T/O 5-37)*

<i>Platoon</i>		<i>Platoon headquarters</i>	
Officers.....	1	Officers.....	1
Enlisted men.....	126	Enlisted men.....	* 9
Tractor, medium, with bulldozer and trailer.....	1	Tractor, medium, with bulldozer and trailer.....	1
Truck, 1½-ton, dump.....	1	Truck, 1½-ton, dump.....	1
Truck, 4-ton, cargo.....	1	Truck, 4-ton, cargo.....	1
Pistol.....	11	Carpenter set.....	2
Rifle.....	116	Demolition set.....	1
		Pioneer set.....	1
		Pistol.....	2
		Rifle.....	8
		<i>9 operating units (squads) each of—</i>	
		Enlisted men.....	^b 13
		Pistol.....	1
		Rifle.....	12

* 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

TABLE XXVII.—*Engineer company, separate battalion*
(T/O 5-37)

<i>Company (A, B, C, or D)</i>		<i>Company headquarters</i>	
Officers.....	4	Officers.....	2
Enlisted men.....	283	Enlisted men.....	^a 31
Air compressor, motorized.....	1	Air compressor, motorized.....	1
Motorcycle, with side car.....	1	Motorcycle, with side car.....	1
Tractor, medium, with bulldozer and trailer.....	2	Trailer, 1-ton, cargo.....	1
Trailer, 1-ton, cargo.....	1	Truck, 1½-ton, pick-up.....	2
Truck, ½-ton, pick-up.....	2	Truck, 1½-ton, dump.....	1
Truck, 1½-ton, dump.....	3	Truck, 2½-ton, cargo.....	1
Truck, 2½-ton, cargo.....	1	Blacksmith set.....	1
Truck, 4-ton, cargo.....	2	Blacksmith set (Q).....	1
Pistol.....	34	Carpenter and wheelwright set (Q).....	1
Rifle.....	253	Drafting and duplicating set.....	1
		Sign-painting set.....	1
		Sketching set.....	1
		Pistol.....	12
		Rifle.....	21
		<i>Platoon</i>	
		Officers.....	1
		Enlisted men.....	^b 126
		Tractor, medium, with bulldozer and trailer.....	1
		Truck, 1½-ton, dump.....	1
		Truck, 4-ton, cargo.....	1
		Tools, see table XXVI.	
		Pistol.....	11
		Rifle.....	116
		<i>Platoon</i>	
		(Same as above.)	

^a 4 privates are fillers and replacements.

^b 11 privates are fillers and replacements.

TABLE XXVIII.—Battalion headquarters, and headquarters and service company, separate battalion (T/O 5-36)

<i>Battalion headquarters</i>		<i>Company headquarters</i>	
Lieutenant colonel (battalion commander).....	1	Captain (S-4).....	1
Major (executive).....	1	Lieutenant.....	1
Captains:		Enlisted men.....	^a 39
Adjutant (S-1).....	1	Air compressor, motorized.....	1
Operations (S-2 and S-3).....	1	Road grader, motorized.....	1
Pistol.....	4	Power shover, with trailer, ½-cubic-yard.....	1
<i>Headquarters and service company</i>		Car, 5-passenger sedan.....	1
Officers.....	2	Motorcycle, solo.....	1
Enlisted men.....	65	Motorcycle, with side car.....	1
Air compressor, motorized.....	1	Trailer, 1-ton, cargo.....	1
Road grader, motorized.....	1	Truck, ½-ton, pick-up.....	3
Power shovel, with trailer, ½-cubic-yard.....	1	Truck, 1½-ton, dump.....	5
Car, 5-passenger sedan.....	1	Truck, 2½-ton, cargo.....	1
Motorcycle, solo.....	1	Truck, 7½-ton, cargo.....	1
Motorcycle, with side car.....	1	Pistol.....	12
Trailer, 1-ton, cargo.....	1	Rifle.....	29
Truck, ½-ton, pick-up.....	3	<i>Administrative section</i>	
Truck, 1½-ton, dump.....	5	Captain (adjutant from battalion headquarters).....	(1)
Truck, 2½-ton, cargo.....	1	Enlisted men.....	6
Truck, 7½-ton, cargo.....	1	Pistol.....	2
B & W printing set.....	1	Rifle.....	4
Blacksmith set.....	1	<i>Engineer section</i>	
Blacksmith set (Q).....	1	Captain (operations from battalion headquarters).....	(1)
Carpenter and wheelwright set (Q).....	1	Enlisted men.....	^b 15
Electric lighting set.....	1	Pistol.....	1
Hammer (gas-operated).....	2	Rifle.....	14
Pipe-fitting set.....	2	<i>Supply section</i>	
Sign-painting set.....	1	Captain (S-4 from company headquarters).....	(1)
Sketching set.....	1	Enlisted men.....	^b 5
Supply equipment set.....	1	Pistol.....	1
Tinsmith set.....	3	Rifle.....	4
Water supply set, including portable purification unit.....	1		
Welding and cutting set.....	2		
Pistol.....	16		
Rifle.....	51		

^a 4 privates are fillers and replacements

^b 1 private is filler and replacement.

TABLE XXIX.—Engineer battalion, separate (T/O 5-35)

		<i>Battalion headquarters</i>	
		Officers.....	4
		Pistol.....	4
		<i>Headquarters and service company</i>	
		Officers.....	2
		Enlisted men.....	65
		Air compressor, motorized.....	1
		Road grader, motorized.....	1
		Power shovel, with trailer, ½-cubic yard.....	1
		Car, 5-passenger sedan.....	1
		Motorcycle, solo.....	1
		Motorcycle, with side car.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	3
		Truck, 1½-ton, dump.....	5
		Truck, 2½-ton, cargo.....	1
		Truck, 7½-ton, cargo.....	1
		Pistol.....	16
		Rifle.....	51
		<i>Company A</i>	
		Officers.....	4
		Enlisted men.....	283
		Air compressor, motorized.....	1
		Motorcycle, with side car.....	1
		Tractor, medium, with bulldozer and trailer.....	2
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, dump.....	3
		Truck, 2½-ton, cargo.....	1
		Truck, 4-ton, cargo.....	2
		Pistol.....	34
		Rifle.....	253
		<i>Company B</i>	
		(Same as above.)	
		<i>Company C</i>	
		(Same as above.)	
		<i>Company D</i>	
		(Same as above.)	
<i>Separate battalion</i>			
Officers.....	22		
Enlisted men.....	1, 197		
Air compressor, motorized.....	5		
Road grader, motorized.....	1		
Power shovel, with trailer, ½-cubic yard.....	1		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	1		
Motorcycle, with side car.....	5		
Tractor, medium, with bulldozer and trailer.....	8		
Trailer, 1-ton, cargo.....	5		
Truck, ½-ton, pick-up.....	11		
Truck, 1½-ton, dump.....	17		
Truck, 2½-ton, cargo.....	5		
Truck, 4-ton, cargo.....	8		
Truck, 7½-ton, cargo.....	1		
Pistol.....	156		
Rifle.....	1, 063		

TABLE XXX.—*Engineer battalion, camouflage, army*
(T/O 5-95)

		<i>Battalion headquarters</i>	
		Officers.....	4
		Pistol.....	4
		<i>Headquarters and service company (table XXXI)</i>	
		Officers.....	3
		Enlisted men.....	^b 94
		Car, 5-passenger sedan.....	1
		Trailer, 1-ton, cargo.....	1
		Motorcycle, with side car.....	1
		Truck, ½-ton, pick-up.....	5
		Truck, 1½-ton, cargo.....	2
		Truck, 2½-ton, cargo.....	1
		Pistol.....	23
		Rifle.....	74
		<i>Company A (table XXXII)</i>	
		Officers.....	5
		Enlisted men.....	^c 77
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	5
		Truck, 1½-ton, cargo.....	5
		Pistol.....	26
		Rifle.....	56
		<i>Company B</i>	
		(Same as above.)	
		<i>Company C</i>	
		(Same as above.)	
		<i>Company D</i>	
		(Same as above.)	
<i>Engineer battalion, camouflage, army</i>			
Officers.....	27		
Enlisted men.....	^a 402		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	4		
Motorcycle, with side car.....	1		
Trailer, 1-ton, cargo.....	5		
Truck, ½-ton, pick-up.....	25		
Truck, 1½-ton, cargo.....	22		
Truck, 2½-ton, cargo.....	1		
Pistol.....	131		
Rifle.....	298		

^a 37 privates are fillers and replacements.

^b 9 privates are fillers and replacements.

^c 7 privates are fillers and replacements.

TABLE XXXI.—*Headquarters and service company, battalion, camouflage, army (T/O 5-96)*

		<i>Company headquarters</i>		<i>Administrative section</i>		
<i>Headquarters and service company</i>	Officers.....	3	Officers.....	1	Enlisted men.....	a 8
	Enlisted men.....	94	Enlisted men.....	a 12	Pistol.....	2
	Car, 5-passenger, sedan.....	1	Pistol.....	8	Rifle.....	6
	Motoreycle, with side car.....	1	Rifle.....	5		
	Trailer, 1-ton, cargo.....	1	<i>Headquarters platoon</i>		<i>Operations section</i>	
	Truck, 1½-ton, pick-up.....	5	Enlisted men.....	b 28	Enlisted men.....	a 14
	Truck, 1½-ton, cargo.....	2	Pistol.....	6	Pistol.....	3
	Truck, 2½-ton, cargo.....	1	Rifle.....	22	Rifle.....	11
	B & W printing set.....	1			<i>Supply section</i>	
	Carpenter set.....	1			Enlisted men.....	a 6
Drafting set.....	1			Pistol.....	1	
Pioneer set.....	1			Rifle.....	5	
Sign-painting set.....	1					
Sketching set.....	4			<i>Platoon headquarters</i>		
Supplementary set.....	1			Officers.....	1	
Tinsmith set.....	1			Enlisted men.....	d 3	
Blacksmith set (Q).....	1			Pistol.....	2	
Carpenter and wheelwright set (Q).....	1			Rifle.....	2	
Pistol.....	23	<i>Service platoon</i>		<i>Factory section</i>		
Rifle.....	74	Officers.....	2	Officers.....	1	
		Enlisted men.....	c 54	Enlisted men.....	d 35	
		Pistol.....	9	Pistol.....	4	
		Rifle.....	47	Rifle.....	32	
		(All transportation.)		<i>Transportation section</i>		
				Enlisted men.....	a 16	
				Pistol.....	3	
				Rifle.....	13	
				(All transportation.)		

^a 1 private is filler and replacement.

^b 3 privates are fillers and replacements.

^c 5 privates are fillers and replacements.

^d 2 privates are fillers and replacements.

TABLE XXXII.—*Camouflage company, engineer battalion, camouflage, army (T/O 5-97)*

		<i>Company headquarters</i>	
		Officers.....	1
		Enlisted men.....	^a 21
		Motorecycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, cargo.....	1
		Pistol.....	10
		Rifle.....	12
<i>Camouflage company (A, B, C, D)</i>		<i>Camouflage platoon</i>	
Officers.....	5	Officers.....	1
Enlisted men.....	77	Enlisted men.....	^b 14
Motorecycle, solo.....	1	Truck, ½-ton, pick-up.....	1
Trailer, 1-ton, cargo.....	1	Truck, 1½-ton, cargo.....	1
Truck, ½-ton, pick-up.....	5	Pistol.....	4
Truck, 1½-ton, cargo.....	5	Rifle.....	11
Carpenter set.....	1	<i>Camouflage platoon</i>	
Carpenter and wheelwright set (Q).....	1	(Same as above.)	
Drafting and duplicating set.....	1	<i>Camouflage platoon</i>	
Pioneer set.....	1	(Same as above.)	
Sign-painting set.....	1	<i>Camouflage platoon</i>	
Sketching set.....	1	(Same as above.)	
Pistol.....	26		
Rifle.....	56		

^a 3 privates are fillers and replacements.

^b 1 private is filler and replacements.

TABLE XXXIII.—Engineer battalion, camouflage, GHQ
(T/O 5-135)

		<i>Battalion headquarters</i>	
		Officers.....	4
		Pistol.....	4
		<i>Headquarters and service company</i> (table XXXIV)	
		Officers.....	2
		Enlisted men.....	^b 53
		Car, 5-passenger sedan.....	1
		Motorcycle, with side car.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, cargo.....	4
		Truck, 2-ton, cargo.....	1
		Pistol.....	15
		Rifle.....	40
		<i>Camouflage company (Company A)</i> (table XXXV)	
		Officers.....	10
		Enlisted men.....	^c 157
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, pick-up.....	11
		Truck, 1½-ton, cargo.....	5
		Pistol.....	40
		Rifle.....	127
		<i>Shop company (Company B)</i> (table XXXVI)	
		Officers.....	6
		Enlisted men.....	^d 198
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo.....	3
		Truck, ½-ton, pick-up.....	3
		Truck, 1½-ton, cargo.....	3
		Truck, 2-ton, cargo.....	1
		Pistol.....	35
		Rifle.....	169
<i>Engineer battalion, camouflage, GHQ</i>			
Officers.....	22		
Enlisted men.....	^a 408		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	2		
Motorcycle, with side car.....	1		
Trailer, 1-ton, cargo.....	5		
Truck, ½-ton, pick-up.....	16		
Truck, 1½-ton, cargo.....	12		
Truck, 2-ton, cargo.....	2		
Pistol.....	94		
Rifle.....	336		

^a 37 privates are fillers and replacements.

^b 5 privates are fillers and replacements.

^c 14 privates are fillers and replacements.

^d 18 privates are fillers and replacements.

TABLE XXXIV.—Headquarters and service company, engineer battalion, camouflage, GHQ (T/O 5-136)

<i>Headquarters and service company</i>		<i>Company headquarters</i>	
Officers.....	2	Officers.....	2
Enlisted men.....	53	Enlisted men.....	^a 27
Car, 5-passenger sedan.....	1	Pistol.....	11
Motorcycle, with side car.....	1	Rifle.....	18
Trailer, 1-ton, cargo.....	1	(All transportation.)	
Truck, ½-ton, pick-up.....	2	<i>Administrative section</i>	
Truck, 1½-ton, cargo.....	4	Enlisted men.....	^b 5
Truck, 2½-ton, cargo.....	1	Pistol.....	1
Blacksmith set (Q).....	1	Rifle.....	4
Carpenter and wheelwright set (Q).....	1	<i>Technical section</i>	
Drafting set.....	1	Enlisted men.....	^b 16
Sign-painting set.....	1	Pistol.....	2
Sketching set.....	1	Rifle.....	14
Supplementary set.....	1	<i>Supply section</i>	
Tinsmith set.....	1	Enlisted men.....	^b 5
Pistol.....	15	Pistol.....	1
Rifle.....	40	Rifle.....	4

^a 2 privates are fillers and replacements.

^b 1 private is filler and replacement.

TABLE XXXV.—*Camouflage company, engineer battalion, camouflage, GHQ (T/O 5-137)*

		<i>Company headquarters</i>	
		Officers.....	2
		Enlisted men.....	* 24
		Motorcycle, solo.....	1
		Trailer, 1-ton, cargo..	1
		Truck, ½-ton, pick-up.....	3
		Truck, 1½-ton, cargo..	1
		Pistol.....	12
		Rifle.....	14
<i>Camouflage company (company A)</i>		<i>Platoon headquarters</i>	
Officers.....	10	Officers.....	2
Enlisted men.....	157	Enlisted men.....	5
Motorcycle, solo.....	1	Truck, ½-ton, pick-up.....	2
Trailer, 1-ton, cargo..	1	Truck, 1½-ton, cargo..	2
Truck, ½-ton, pick-up.....	11	Pistol.....	3
Truck, 1½-ton, cargo..	5	Rifle.....	4
Blacksmith set (Q)...	1	<i>Depot section</i>	
Carpenter and wheelwright set (Q).....	1	Enlisted men.....	d 19
Drafting and duplicating set.....	1	Pistol.....	3
Sign-painting set.....	1	Rifle.....	16
Sketching set.....	1	<i>School section</i>	
Pistol.....	40	Enlisted men.....	* 51
Rifle.....	127	Pistol.....	3
		Rifle.....	48
		<i>Platoon headquarters</i>	
		Officers.....	2
		Enlisted men.....	5
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, cargo..	2
		Pistol.....	3
		Rifle.....	4
		<i>Camouflage section</i>	
		Officers.....	4
		Enlisted men.....	* 53
		Truck, ½-ton, pick-up.....	4
		Pistol.....	16
		Rifle.....	41
		<i>Headquarters platoon</i>	
		Officers.....	2
		Enlisted men.....	b 75
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, cargo..	2
		Pistol.....	9
		Rifle.....	68
		<i>Camouflage platoon</i>	
		Officers.....	6
		Enlisted men.....	* 58
		Truck, ½-ton, pick-up.....	6
		Truck, 1½-ton, cargo..	2
		Pistol.....	19
		Rifle.....	45

* 3 privates are fillers and replacements. d 2 privates are fillers and replacements.

b 6 privates are fillers and replacements. * 4 privates are fillers and replacements.

* 5 privates are fillers and replacements.

TABLE XXXVI.—*Shop company, engineer battalion, camouflage, GHQ (T/O 5-138)*

				<i>Platoon headquarters</i>	
			<i>Company headquarters</i>	Officers.....	2
			Officers.....	Enlisted men.....	3
			Enlisted men.....	Pistol.....	4
			Motorcycle, solo.....	Rifle.....	1
			Pistol.....		
			Rifle.....	<i>Supply section</i>	
				Enlisted men.....	^a 10
				Pistol.....	3
				Rifle.....	7
			<i>Headquarters platoon</i>		
			Officers.....	<i>Transportation section</i>	
			Enlisted men.....	Enlisted men.....	^a 9
			Trailer, 1-ton, cargo.....	Rifle.....	9
			Truck, ½-ton, pick-up.....	(All platoon transportation.)	
			Truck, 1½-ton, cargo.....		
			Truck, 2½-ton, cargo.....	<i>Repair and maintenance section</i>	
			Pistol.....	Enlisted men.....	^a 37
			Rifle.....	Pistol.....	3
				Rifle.....	34
				<i>Design section</i>	
				Enlisted men.....	^f 33
				Pistol.....	4
				Rifle.....	29
				<i>Platoon headquarters</i>	
				Officers.....	2
				Enlisted men.....	^a 4
				Pistol.....	4
				Rifle.....	2
			<i>Factory platoon</i>		
			Officers.....	<i>Sewing and weaving section</i>	
			Enlisted men.....	Enlisted men.....	^a 43
			Pistol.....	Pistol.....	3
			Rifle.....	Rifle.....	40
				<i>Painting section</i>	
				Enlisted men.....	^a 42
				Pistol.....	3
				Rifle.....	39

^a 2 privates are fillers and replacements.

^b 9 privates are fillers and replacements.

^c 7 privates are fillers and replacements.

^d 1 private is filler and replacement.

^e 3 privates are fillers and replacements.

^f 4 privates are fillers and replacements.

TABLE XXXVII.—*Engineer company, light ponton (T/O 5-87)*

		<i>Company headquarters</i>	
		Officers.....	2
		Enlisted men.....	* 22
		Motorcycle, solo....	1
		Trailer, 1-ton, cargo..	1
		Truck, ½-ton, command.....	1
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, cargo.....	1
		Truck, 2½-ton, cargo, with winch....	1
		Pistol, cal. .45.....	12
		Rifle.....	12
		<i>Assault boat section</i>	
		Enlisted men.....	* 22
		Assault boat.....	80
		Truck, 1½-ton, cargo.....	8
		Pistol, cal. .45.....	1
		Rifle.....	21
		<i>Footbridge section</i>	
		Enlisted men.....	* 23
		Footbridge, M1938..	2
		Truck, 1½-ton, cargo.....	8
		Pistol, cal. .45.....	1
		Rifle.....	22
		<i>Service and repair section</i>	
		Officers.....	1
		Enlisted men.....	* 19
		Welding set.....	1
		Blacksmith set.....	1
		Blacksmith set (Q)....	1
		Canvas workers set....	1
		Carpenter set.....	1
<i>Engineer company, light ponton</i>		<i>Headquarters platoon</i>	
Officers.....	6	Officers.....	3
Enlisted men.....	215	Enlisted men.....	* 86
Assault boat.....	80	Assault boat.....	80
Footbridge, M1938..	2	Drafting and duplicating set.....	1
Ponton bridge, 10-ton (250-foot).....	3	Footbridge, M1938..	2
Welding set.....	1	Sketching set.....	1
Trailer, ponton equipage.....	99	Motorcycle, solo....	1
		Trailer, 1-ton, cargo..	2
		Truck, ½-ton, command.....	1
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, cargo.....	18
		Truck, 2½-ton, cargo, with winch....	2
		Pistol, cal. .45.....	18
		Rifle.....	73

* 8 privates are fillers and replacements.

* 2 privates are fillers and replacements.

Motorcycle, solo.....	1			Carpenter and wheelwright set (Q).....	1
Motorcycle, with side car.....	3			Sign-painting set.....	1
Trailer, 1-ton, cargo.....	5			Tinsmith set.....	1
Trailer, tilting, for light tractor.....	6			Trailer, 1-ton, cargo.....	1
Truck, ½-ton, command.....	1			Truck, ½-ton, pick-up.....	1
Truck, ½-ton, pick-up.....	5			Truck, 1½-ton, cargo.....	1
Truck, 1½-ton cargo.....	21			Truck, 2½-ton, cargo, with winch....	1
Truck, 2½-ton, cargo, with winch....	1			Pistol, cal. .45.....	2
Truck, 4-ton, cargo W/12-foot loading bed.....	18			Rifle.....	18
Tractor, light.....	6				
Truck, tractor, 4-ton, prime mover for engineer equipment....	18				
Truck, wrecker, 4-ton.....	1				
Pistol, cal. .45.....	31				
Rifle.....	190				
		<i>Bridge platoon</i>		<i>Platoon headquarters</i>	
		Officers.....	1	Officers.....	1
		Enlisted men.....	^b 43	Enlisted men.....	^d 13
		Ponton bridge, 10-ton (250-foot).....	3	Trailer, ponton equipage.....	* 1
		Trailer, ponton equipage.....	33	Motorcycle, with side car.....	1
		Motorcycle, with side car.....	1	Trailer, 1-ton, cargo.....	* 1
		Trailer, 1-ton, cargo.....	1	Truck, ½-ton, pick-up.....	1
		Truck, ½-ton, pick-up.....	1	Truck, 1½-ton, cargo.....	* 3
		Truck, 1½-ton, cargo.....	3	Pistol, cal. .45.....	3
		Truck, 4-ton cargo, W/12-foot loading bed.....	6	Rifle.....	11
		Tractor, light.....	2		
		Pioneer set.....	1	<i>Ponton section</i>	
		Pistol, cal. .45.....	5	Enlisted men.....	^d 15
		Rifle.....	39	Trailer, ponton equipage.....	* 16
				Truck, 2½-ton, cargo, with winch....	1
		<i>Bridge platoon</i>		Tractor, light.....	1
		(Same as above.)		Pistol, cal. .45.....	1
		<i>Bridge platoon</i>		Rifle.....	14
		(Same as above.)		<i>Ponton section</i>	
				(Same as above.)	

^b 4 privates are fillers and replacements.

^d 1 private is filler and replacement.

* Part of ponton bridge unit.

TABLE XXXVIII.—*Engineer battalion, heavy ponton (T/O 5-275)*

<i>Engineer battalion, heavy ponton</i>		<i>Battalion headquarters</i>	
Officers.....	12	Officers.....	2
Enlisted men..... ^a	462	Pistol.....	2
Ponton bridge, 25-ton (250-foot).....	4	<i>Headquarters and service company</i>	
Boat, power, utility..... ^d	4	Officers.....	2
Air compressor.....	1	Enlisted men..... ^b	82
Crane, portable..... ^d	8	Air compressor.....	1
Motor, outboard..... ^d	16	Motorcycle, solo.....	1
Motorcycle, solo.....	3	Trailer, ¾-ton, cargo.....	1
Semitrailer..... ^d	64	Truck, command and reconnaissance.....	2
Tractor, medium, with trailer.....	8	Truck, ½-ton, pick-up.....	2
Trailer, boat..... ^d	4	Truck, 2½-ton.....	5
Trailer, ¾-ton, cargo.....	3	Machine gun, cal. .30.....	4
Truck, command and reconnaissance.....	4	Pistol.....	84
Truck, ½-ton, pick-up.....	10	<i>Company A</i>	
Truck, 2½-ton..... (12 ^d)	23	Officers.....	4
Truck, 4-ton, cargo..... ^d	8	Enlisted men..... ^c	190
Truck, 4-ton, tractor..... ^d	64	Ponton bridge, 25-ton (250-foot).....	2
Truck, crane.....	2	Boat, power, utility.....	2
Machine gun, cal. .30.....	20	Crane, portable.....	4
Pistol, cal. .45.....	474	Motor, outboard.....	8
		Motorcycle, solo.....	1
		Semitrailer.....	32
		Tractor, medium, with trailer.....	4
		Trailer, boat.....	2
		Trailer, ¾-ton, cargo.....	1
		Truck, command and reconnaissance.....	1
		Truck, ½-ton, pick-up.....	4
		Truck, 2½-ton.....	9
		Truck, 4-ton, cargo.....	4
		Truck, 4-ton, tractor.....	32
		Truck, crane.....	1
		Machine gun, cal. .30.....	8
		Pistol.....	194
		<i>Company B</i>	
		(Same as Company A)	

^a 41 privates are fillers and replacements.

^b 7 privates are fillers and replacements.

^c 17 privates are fillers and replacements.

^d Part of ponton bridge units and their prime movers.

TABLE XXXIX.—*Battalion headquarters and headquarters and service company, heavy ponton battalion (T/O 5-276)*

		<i>Company headquarters</i>	
		Officers.....	2
		Enlisted men.....	^b 16
		Motorcycle, solo.....	1
		Truck, ½-ton, command and reconnaissance.....	2
		Trailer, ¾-ton, cargo.....	1
		Truck, 2½-ton.....	1
		Drafting and duplicating set.....	1
		Pistol.....	18
		<i>Administrative section</i>	
		Enlisted men.....	^b 7
		Machine gun, cal. .30.....	1
		Pistol.....	7
		<i>Supply section</i>	
		Enlisted men.....	^b 10
		Machine gun, cal. .30.....	1
		Pistol.....	10
		<i>Maintenance platoon</i>	
		Enlisted men.....	^c 49
		Air compressor.....	1
		Blacksmith set.....	1
		Blacksmith set (Q).....	1
		Carpenter set.....	1
		Carpenter and wheelwright set (Q).....	1
		Pioneer set.....	1
		Sign-painting set.....	1
		Sketching set.....	1
		Tinsmith set.....	3
		Welding and cutting set.....	1
		Truck, ½-ton, pick-up.....	2
		Truck, 2½-ton.....	4
		Machine gun, cal. .30.....	2
		Pistol.....	49
<i>Battalion headquarters</i>			
Major (battalion commander).....	1		
Captain (S-1).....	1		
Pistol.....	2		
<i>Headquarters and service company</i>			
Officers.....	2		
Enlisted men.....	^a 82		
Machine gun, cal. .30.....	4		
Pistol.....	84		

^a 7 privates are fillers and replacements.

^b 1 private is filler and replacement.

^c 4 privates are fillers and replacements.

**TABLE XL.—Lettered company, heavy ponton battalion
(T/O 5-277)**

		<i>Administrative section</i>	
<i>Headquarters platoon</i>		Officers.....	2
Officers.....	2	Enlisted men.....	13
Enlisted men.....	^b 36	Truck, ½-ton, com- mand and recon- naissance.....	1
Truck, ½-ton, com- mand and recon- naissance.....	1	Pistol.....	15
Motorcycle, solo.....	1	<i>Service section</i>	
Trailer, ¾-ton.....	1	Enlisted men.....	^b 23
Truck, ½-ton, pick- up.....	2	Motorcycle, solo.....	1
Truck, 2½-ton.....	3	Trailer, 1-ton.....	1
Truck, crane.....	1	Truck, ½-ton, pick- up.....	2
Blacksmith set.....	1	Truck, 2½-ton.....	3
Blacksmith set (Q).....	1	Truck, crane.....	1
Carpenter set.....	1	Machine gun, cal. .30.....	2
Carpenter and wheel- right set (Q).....	1	Pistol.....	23
Sign-painting set.....	1	<i>Platoon headquarters</i>	
Machine gun, cal. .30.....	2	Officer.....	1
Pistol.....	38	Enlisted men.....	^d 30
<i>Company (A or B)</i>		Boat, power, utility.....	1
Officers.....	4	Crane, portable.....	2
Enlisted men.....	^a 190	Motor, outboard, 32- hp.....	4
Machine gun, cal. .30.....	8	Tractor, medium, with trailer.....	2
Pistol.....	194	Trailer, boat.....	1
<i>Bridge platoon</i>		Truck, ½-ton, pick- up.....	1
Officers.....	1	Truck, 2½-ton.....	3
Enlisted men.....	^c 77	Truck, 4-ton, cargo.....	2
Ponton bridge, 25- ton (250-foot).....	1	Machine gun, cal. .30.....	3
Boat, power, utility.....	^f 1	Pistol.....	31
Crane, portable.....	^f 2		
Motor, outboard 32- hp.....	^f 4		
Semitrailer.....	^f 16		

^a 17 privates are fillers and replacements.

^b 3 privates are fillers and replacements.

^c 7 privates are fillers and replacements.

^d 2 privates are fillers and replacements.

^e 1 private is filler and replacement.

^f Part of ponton bridge unit and its prime movers.

Tractor, medium, with trailer.....	2	<i>Ponton section</i>	
Trailer, boat.....	f 1	{	Enlisted men..... • 11
Truck, ½-ton, pick- up.....	1		Semitrailer..... 4
Truck, 2½-ton.....	f 3		Truck, 4-ton, tractor.. 4
Truck, 4-ton, cargo..	2		Pistol..... 11
Truck, 4-ton, trac- tor.....	f 16	<i>Ponton section</i>	
Machine gun, cal. .30.....	3	(Same as above.)	
Pistol.....	78	<i>Ponton section</i>	
<i>Bridge platoon</i>		(Same as above.)	
(Same as above.)		<i>Trestle section</i>	
		{	Enlisted men..... • 7
			Semitrailer..... 2
			Truck, 4-ton, tractor.. 2
			Pistol..... 7
		<i>Trestle section</i>	
		(Same as above.)	

TABLE XLI.—*Engineer battalion, railway operating*
(T/O 5-125)

		<i>Battalion headquarters</i>	
		Officers.....	3
		Pistol.....	3
		<i>Headquarters and service company</i>	
		Officers.....	3
		Enlisted men.....	^a 106
		Car, 5-passenger sedan.....	1
		Motorcycle, solo.....	1
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, cargo.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
		Pistol.....	36
		Rifle.....	73
		<i>Maintenance of way (Company A)</i>	
		Officers.....	4
		Enlisted men.....	^b 190
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, cargo.....	1
		Blacksmith set.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
		Carpenter set.....	3
		Drafting set.....	1
		Pioneer set.....	3
		Pipe-fitting set.....	4
		Tinsmith set.....	1
		Pistol.....	28
		Rifle.....	166
		<i>Maintenance of equipment (Company B)</i>	
		Officers.....	4
		Enlisted men.....	^b 182
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, cargo.....	1
		Blacksmith set.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
<i>Engineer battalion, railway operating</i>			
Officers.....	18		
Enlisted men.....	803		
Car, 5-passenger sedan.....	1		
Motorcycle, solo.....	1		
Truck, ½-ton, pick-up.....	5		
Truck, 1½-ton, cargo.....	4		
Pistol.....	424		
Rifle.....	397		

^a 10 privates are fillers and replacements.

^b 17 privates are fillers and replacements.

Canvas worker's set.....	1
Drafting set.....	1
Pipe-fitting set.....	4
Sign-painting set.....	1
Tinsmith set.....	1
Pistol.....	28
Rifle.....	158
<i>Transportation (Company C)</i>	
Officers.....	4
Enlisted men.....	* 325
Truck, 1/2-ton, pick-up.....	1
Truck, 1 1/4-ton, cargo.....	1
Pistol.....	329

* 29 privates are fillers and replacements.

TABLE XLII.—*Engineer battalion, railway shop (T/O 5-145)*

		<i>Battalion headquarters</i>	
		Officers.....	3
		Pistol.....	3
		<i>Headquarters and service company</i>	
		Officers.....	4
		Enlisted men.....	^a 115
		Car, 5-passenger sedan.....	1
		Motorecycle, with side car.....	1
		Truck, ½-ton, pick-up.....	2
		Truck, 1½-ton, cargo.....	1
		B & W printing set.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
		Drafting and duplicating set.....	1
		Drafting set.....	1
		Pipe-fitting set.....	2
		Pistol.....	119
		<i>Erecting and machine shop company (Company A)</i>	
		Officers.....	3
		Enlisted men.....	^b 109
		Truck ½-ton, pick-up.....	1
		Truck, 1½-ton, cargo.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
		Drafting and duplicating set.....	1
		Sign-painting set.....	3
		Pistol.....	191
		<i>Boiler and smith shop company (Company B)</i>	
		Officers.....	4
		Enlisted men.....	^c 180
		Truck, ½-ton, pick-up.....	1
		Truck, 1½-ton, cargo.....	1
		Blacksmith set (Q).....	1
		Carpenter and wheelwright set (Q).....	1
		Drafting and duplicating set.....	1
		Pipe-fitting set.....	4
		Tinsmith set.....	3
		Pistol.....	184
<i>Engineer battalion, railway shop</i>			
Officers.....	20		
Enlisted men.....	642		
Car, 5-passenger sedan.....	1		
Motorecycle, with side car.....	1		
Truck, ½-ton, pick-up.....	5		
Truck, 1½-ton, cargo.....	4		
Pistol.....	662		

^a 11 privates are fillers and replacements.

^b 17 privates are fillers and replacements.

^c 16 privates are fillers and replacements.

Car repair company (Company C)

Officers.....	4
Enlisted men.....	157
Truck, ½-ton, pick-up.....	1
Truck, 1½-ton, cargo.....	1
Blacksmith set (Q).....	1
Canvas worker's set.....	1
Carpenter set.....	1
Carpenter and wheelwright set (Q).....	1
Drafting and duplicating set.....	1
Pipe-fitting set.....	4
Sign-painting set.....	1
Pistol.....	161

TABLE XLIII.—Engineer company, topographic, corps
(T/O 5-167)

<i>Engineer company, topographic, corps</i>		<i>Company headquarters</i>	
Officers.....	5	Officers.....	2
Enlisted men.....	^a 115	Enlisted men.....	^b 28
Motorcycle, with side car.....	1	Motorcycle, with side car.....	1
Trailer, 1-ton, cargo.....	5	Trailer, 1-ton, cargo.....	2
Trailer, copying camera.....	1	Truck, ½-ton, command.....	1
Trailer, map reproduction.....	2	Truck, ½-ton, pick-up.....	2
Truck, ½-ton, carry-all.....	2	Truck, 1½-ton, cargo.....	5
Truck, ½-ton, command.....	1	Pistol.....	30
Truck, ½-ton, pick-up.....	2		
Truck, 1½-ton, cargo.....	12	<i>Survey platoon</i>	
Truck, 1½-ton, tractor.....	3	Officers.....	1
B & W printing set.....	1	Enlisted men.....	^b 35
Blacksmith set (Q).....	1	Trailer, 1-ton, cargo.....	1
Canvas worker's set.....	1	Truck, ½-ton, carry-all.....	2
Carpenter set.....	1	Truck, 1½-ton, cargo.....	2
Carpenter and wheelwright set (Q).....	1	Pistol.....	36
Duplicating set.....	1		
Electric light set.....	1	<i>Photomapping platoon</i>	
Map reproduction set, mobile.....	1	Officers.....	1
Photomapping set.....	1	Enlisted men.....	^c 24
Pioneer set.....	2	Truck, 1½-ton, cargo.....	2
Pipe-fitting set.....	1	Pistol.....	25
Sign-painting set.....	1		
Sketching set.....	2	<i>Reproduction platoon</i>	
Stereocomparagraph set.....	3	Officers.....	1
Supplementary set.....	1	Enlisted men.....	^b 28
Surveying set.....	1	Trailer, 1-ton, cargo.....	2
Tinsmith set.....	1	Trailer, copying camera.....	1
Water supply set, topographic bat-		Trailer, map reproduction.....	2
talion.....	1	Truck, 1½-ton, cargo.....	3
Pistol.....	120	Truck, 1½-ton, tractor.....	3
		Water supply set, topographic bat-	
		talion.....	1
		Pistol.....	29

^a 11 privates are fillers and replacements.

^b 3 privates are fillers and replacements.

^c 2 privates are fillers and replacements.

TABLE XLIV.—Engineer battalion, topographic, army
(T/O 5-55)

		<i>Battalion headquarters</i>	
		Officers.....	4
		Pistol.....	4
		<i>Headquarters and service company (table XLV)</i>	
		Officers.....	6
		Enlisted men.....	^b 112
		Car, 5-passenger sedan.....	1
		Motorcycle, with side car.....	3
		Trailer, 1-ton, cargo.....	1
		Trailer, 1-ton, water.....	1
		Trailer, triangulation tower.....	12
		Truck, ½-ton, carry-all.....	7
		Truck, 1½-ton, cargo.....	20
		Truck, 2½-ton, cargo.....	6
		Truck, 2½-ton, tank.....	1
		Triangulation tower, portable.....	6
		Pistol.....	118
		<i>Survey company (Company A)</i> (Table XLVI)	
		Officers.....	5
		Enlisted men.....	^c 184
		Motorcycle, with side car.....	2
		Trailer, 1-ton, cargo.....	8
		Trailer, 1-ton, water.....	1
		Trailer, triangulation tower.....	4
		Truck, ½-ton, carry-all.....	12
		Truck, 1½-ton, cargo.....	15
		Truck, 2½-ton, cargo.....	2
		Triangulation tower, portable.....	2
		Pistol.....	189
		<i>Survey company (Company D)</i> (Same as company A above.)	
		<i>Photomapping company (Company B)</i> (table XLVII)	
		Officers.....	9
		Enlisted men.....	^d 286
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, carry-all.....	2
		Truck, 1½-ton, cargo.....	4
		Pistol.....	295
<i>Engineer battalion, topographic, army</i>			
		Officers.....	37
		Enlisted men.....	^a 994
		Car, 5-passenger sedan.....	1
		Motorcycle, with side car.....	8
		Trailer, 1-ton, cargo.....	19
		Trailer, 1-ton, water.....	4
		Trailer, camera.....	1
		Trailer, grainier.....	1
		Trailer, laboratory and supply.....	1
		Trailer, photo.....	1
		Trailer, press offset, medium.....	3
		Trailer, plate.....	1
		Trailer, triangulation tower.....	20
		Truck, ½-ton, carry-all.....	35
		Truck, 1½-ton, cargo.....	57
		Truck, 2½-ton, cargo.....	23
		Truck 2½-ton, tank.....	1
		Truck, 2½-ton, tractor.....	8
		Camera, process.....	1
		Press, rotary offset, small.....	2
		Press, rotary offset, medium.....	2
		Triangulation tower, portable.....	10

^a 91 privates are fillers and replacements.

^b 10 privates are fillers and replacements.

^c 17 privates are fillers and replacements.

^d 26 privates are fillers and replacements.

Water supply set, topographic bat- talion.....	1
Pistol.....	1,031

Reproduction company (Company C)
(table XLVIII)

Officers.....	8
Enlisted men.....	* 228
Motorecycle, with side car.....	1
Trailer, 1-ton, cargo.....	1
Trailer, 1-ton, water.....	1
Trailer, camera.....	1
Trailer, grainer.....	1
Trailer, laboratory and supply....	1
Trailer, photo.....	1
Trailer, offset press, medium.....	3
Trailer, process plate.....	1
Truck, ½-ton, carry-all.....	2
Truck, 1½-ton, cargo.....	3
Truck, 2½-ton, cargo.....	13
Truck, 2½-ton, tractor.....	8
Camera, process.....	1
Press, rotary offset, medium.....	2
Press, rotary offset, small.....	2
Water supply set, topographic battalion.....	1
Pistol.....	236

* 21 privates are fillers and replacements.

TABLE XLV.—Headquarters and service company, engineer battalion, topographic, Army or GHQ (T/O 5-56)

<i>Headquarters and service company, engineer battalion, topographic, Army or GHQ</i>		<i>Company headquarters</i>	
Officers.....	6	Officers.....	2
Enlisted men.....	^a 112	Enlisted men.....	^a 19
Car, 5-passenger sedan.....	1	Pistol.....	21
Motorcycle, with side car.....	3	<i>Administration section</i>	
Trailer, 1-ton, cargo.....	1	Enlisted men.....	^b 10
Trailer, 1-ton, water.....	1	Pistol.....	10
Trailer, Triangulation tower.....	12	<i>Operations section</i>	
Truck, ½-ton, carry-all.....	7	Officers.....	1
Truck, 1½-ton, cargo.....	20	Enlisted men.....	16
Truck, 2½-ton, cargo.....	6	Pistol.....	17
Truck, 2½-ton, tank.....	1	<i>Supply section</i>	
Tower, triangulation, portable.....	6	Officers.....	1
Blacksmith set (Q).....	1	Enlisted men.....	^b 6
Carpenter set.....	1	Pistol.....	7
Carpenter and wheelwright set (Q).....	1	<i>Transportation section</i>	
Drafting set.....	1	Officers.....	1
Drafting and duplicating set.....	1	Enlisted men.....	^a 52
Electricians set.....	1	Pistol.....	53
Pipe-fitting set.....	1	(All company transportation.)	
Press, lithographic, hand, transfer.....	1	<i>Map storage and distribution section</i>	
Sketching set.....	2	Officers.....	1
Surveying set.....	1	Enlisted men.....	^c 9
Tinsmith set.....	1	Pistol.....	10
Pistol.....	^d 118		

^a 3 privates are fillers and replacements.

^b 1 private is filler and replacement.

^c 2 privates are fillers and replacements.

^d Headquarters and service company of GHQ topographic battalion has 110 enlisted men and 116 pistols; otherwise identical.

TABLE XLVI.—*Survey company, engineer battalion, topographic, army or GHQ (T/O 5-58)*

<i>Survey company, engineer battalion, topographic, army or GHQ</i>		<i>Company headquarters</i>	
Officers.....	5	Officers.....	3
Enlisted men.....	184	Enlisted men.....	^a 74
Motorcycle, with side car.....	2	Motorcycle, with side car.....	2
Trailer, 1-ton, cargo.....	8	Trailer, 1-ton, cargo.....	8
Trailer, 1-ton, water.....	1	Trailer, 1-ton, water.....	1
Trailer, triangulation tower.....	4	Truck, ½-ton, carry-all.....	4
Truck, ½-ton, carry-all.....	12	Truck, 1½-ton, cargo.....	5
Truck, 1½-ton, cargo.....	15	Pistol.....	77
Truck, 2½-ton, cargo.....	2		
Tower, triangulation, portable.....	2	<i>Survey platoon</i>	
Carpenter set.....	1	Officers.....	1
Demolition set.....	1	Enlisted men.....	^b 55
Electric lighting set.....	1	Trailer, triangulation tower.....	2
Pipe-fitting set.....	1	Truck, ½-ton, carry-all.....	4
Sign-painting set.....	1	Truck, 1½-ton, cargo.....	5
Surveying set.....	1	Truck, 2½-ton, cargo.....	1
Tinsmith set.....	1	Tower, triangulation, portable.....	1
Pistol.....	189	Pistol.....	56
		<i>Survey platoon</i>	
		(Same as above.)	

^a 7 privates are fillers and replacements.

^b 5 privates are fillers and replacements.

TABLE XLVII.—Photomapping company, engineer battalion, topographic, army or GHQ (T/O 5-59)

<i>Photomapping company, engineer battalion, topo- graphic, army or GHQ</i>	<i>Company headquarters</i>		<i>Platoon headquarters</i>	
	Officers.....	3	Officers.....	2
Officers.....	9	Enlisted men..... ^a 43	Enlisted men..... ^b 11	
Enlisted men.....	286	Pistol.....	Pistol.....	13
Trailer, 1-ton, cargo..	1	(All company trans- portation.)	<i>Multiplex section</i>	
Truck, 1½-ton, carry- all.....	2	<i>Mapping platoon</i>	Enlisted men.....	21
Truck, 1½-ton, cargo.	4		Pistol.....	21
Ammonia printing set.	1	Officers.....	<i>Photolaboratory section</i>	
Carpenter set.....	1	Enlisted men..... ^b 81	Enlisted men.....	3
Drafting set.....	1	Pistol.....	Pistol.....	3
Electrician's set.....	1	83	<i>Stereocomparagraph section</i>	
Multiplex set.....	1	<i>Mapping platoon</i>	Enlisted men.....	12
Pioneer set.....	1		Pistol.....	12
Pipe-fitting set.....	1	(Same as above.)	<i>Plotting section</i>	
Sign-painting set.....	1	<i>Mapping platoon</i>	Enlisted men.....	12
Stereocomparagraph set.....	30		Pistol.....	12
Tinsmith set.....	1	(Same as above.)	<i>Drafting section</i>	
Pistol.....	295		Enlisted men.....	22
			Pistol.....	22

• 2 privates are fillers and replacements.

^b 8 privates are fillers and replacements.

TABLE XLVIII.—*Reproduction company, engineer battalion, topographic, army (T/O 5-57)*

		<i>Company headquarters</i>	
		Officers.....	3
		Enlisted men.....	^a 35
		Trailer, 1-ton, cargo..	1
		Trailer, 1-ton, water..	1
		Truck, ½-ton, carry- all.....	1
		Truck, 1½-ton, cargo..	2
		Truck, 2½-ton, cargo..	1
		Camera, process.....	1
		Press, rotary offset, medium.....	2
		Press, rotary offset, small.....	2
		Pistol.....	38
		<i>Platoon headquarters</i>	
		Officers.....	1
		Enlisted men.....	^b 8
		Pistol.....	9
		<i>Drafting section</i>	
		Enlisted men.....	9
		Pistol.....	9
		<i>Photographic section</i>	
		Enlisted men.....	8
		Pistol.....	8
		<i>Plate section</i>	
		Enlisted men.....	8
		Pistol.....	8
		<i>Press and finishing section</i>	
		Enlisted men.....	13
		Pistol.....	13
		<i>Lithographic platoon</i>	
		Officers.....	1
		Enlisted men.....	^b 46
		Pistol.....	47
		<i>Lithographic platoon</i>	
		(Same as above)	
		<i>Reproduction company, engineer battalion, topographic, army</i>	
Officers.....	8		
Enlisted men.....	228		
Motorcycle, with side car.....	1		
Trailer, 1-ton, cargo..	1		
Trailer, 1-ton, water..	1		
Trailer, camera.....	1		
Trailer, grainer.....	1		
Trailer, laboratory and supply.....	1		
Trailer, photo.....	1		
Trailer, offset press, medium.....	3		
Trailer, process plate.	1		
Truck, ½-ton, carry- all.....	2		
Truck, 1½-ton, cargo..	3		
Truck, 2½-ton, cargo..	13		
Truck, 2½-ton, trac- tor.....	8		
Camera, process.....	1		

^a 5 privates are fillers and replacements.

^b 3 privates are fillers and replacements.

TROOPS AND OPERATIONS

Press, rotary offset, medium.....	2		
Press, rotary offset, small.....	2		
Carpenter set.....	1		
Drafting set.....	1		
Duplicating set.....	1		
Electrician's set.....	1		
Pioneer set.....	1		
Pipe-fitting set.....	1		
Reproduction set, mo- bile.....	1		
Reproduction set, lithograph platoon ..	1		
Sign-painting set.....	1		
Tinsmith set.....	1		
Pistol.....	236		
		<i>Mobile reproduction platoon</i>	
		Officers.....	3
		Enlisted men.....	101
		Motorcycle, with side car.....	1
		Trailer, camera.....	1
		Trailer, grainer.....	1
		Trailer, laboratory and supply.....	1
		Trailer, photo.....	1
		Trailer, offset press, medium.....	3
		Trailer, process plate.....	1
		Truck, 1½-ton, carry- all.....	1
		Truck, 1½-ton, cargo.....	1
		Truck, 2½-ton, cargo.....	12
		Truck, 2½-ton, trac- tor.....	8
		Pistol.....	104
		<i>Platoon headquarters</i>	
		Officers.....	1
		Enlisted men.....	35
		Pistol.....	36
		(All platoon transpor- tation.)	
		<i>Mobile reproduction section</i>	
		Officers.....	1
		Enlisted men.....	33
		Pistol.....	34
		<i>Mobile reproduction section</i>	
		(Same as above.)	

* 3 privates are fillers and replacements.

* 10 privates are fillers and replacements.

* 4 privates are fillers and replacements.

TABLE XLIX.—Engineer battalion, topographic, GHQ
(T/O 5-185)

		<i>Battalion headquarters</i>	
		Officers.....	4
		Pistol.....	4
		<i>Headquarters and service company (table XLV)</i>	
		Officers.....	6
		Enlisted men.....	^b 110
		Car, 5-passenger, sedan.....	1
		Motorcycle, with side car.....	3
		Trailer, 1-ton, cargo.....	1
		Trailer, 1-ton, water.....	1
		Trailer, triangulation tower.....	12
		Truck, ½-ton, carry-all.....	7
		Truck, 1½-ton, cargo.....	20
		Truck, 2½-ton, cargo.....	6
		Truck, 2½-ton, tank.....	1
		Triangulation tower, portable.....	6
		Pistol.....	116
		<i>Survey company (Company A) (table XLVI)</i>	
		Officers.....	5
		Enlisted men.....	^c 184
		Motorcycle, with side car.....	2
		Trailer, 1-ton, cargo.....	8
		Trailer, 1-ton, water.....	1
		Trailer, triangulation tower.....	4
		Truck, ½-ton, carry-all.....	12
		Truck, 1½-ton, cargo.....	15
		Truck, 2½-ton, cargo.....	2
		Triangulation tower, portable.....	2
		Pistol.....	189
		<i>Photomapping company (Company B) (table XLVII)</i>	
		Officers.....	9
		Enlisted men.....	^d 286
		Trailer, 1-ton, cargo.....	1
		Truck, ½-ton, carry-all.....	2
		Truck, 1½-ton, cargo.....	4
		Pistol.....	295
<i>Engineer battalion, Topographic, GHQ</i>			
Officers.....	29		
Enlisted men.....	^a 767		
Car, 5-passenger, sedan.....	1		
Motorcycle, with side car.....	5		
Trailer, 1-ton, cargo.....	11		
Trailer, 1-ton, water.....	3		
Trailer, triangulation tower.....	16		
Truck, ½-ton, carry-all.....	22		
Truck, 1½-ton, cargo.....	42		
Truck, 2½-ton, cargo.....	14		
Truck, 2½-ton, tank.....	1		
Camera, copying.....	1		
Press, rotary offset, large.....	2		
Press, rotary offset, medium.....	2		
Triangulation tower, portable.....	8		
Pistol.....	796		

^a 70 privates are fillers and replacements.

^b 10 privates are fillers and replacements.

^c 17 privates are fillers and replacements.

^d 26 privates are fillers and replacements.

Reproduction company
(Company C) (table L)

Officers.....	5
Enlisted men.....	* 187
Trailer, 1-ton, cargo.....	1
Trailer, 1-ton, water.....	1
Truck, ½-ton, carry-all.....	1
Truck, 1½-ton, cargo.....	3
Truck, 2½-ton, cargo.....	6
Camera, copying.....	1
Press, rotary offset, large.....	2
Press, rotary offset, medium.....	2
Pistol.....	192

* 18 privates are fillers and replacements.

TABLE L.—*Reproduction company, engineer battalion, topographic, GHQ (T/O 5-187)*

<i>Reproduction company, engineer battalion, topographic, GHQ</i>					
Officers.....	5			<i>Platoon headquarters</i>	
Enlisted men.....	187	<i>Company headquarters</i>		Officers.....	1
Trailer, 1-ton, cargo..	1	Officers.....	2	Enlisted men.....	^b 9
Trailer, 1-ton, water..	1	Enlisted men.....	^a 40	Pistol.....	10
Truck, ½-ton, carry- all.....	1	Pistol.....	42	<i>Drafting section</i>	
Truck, 1½-ton, cargo..	3	(All company equip- ment.)		Enlisted men.....	10
Truck, 2½-ton, cargo..	6	<i>Lithographic platoon</i>		Pistol.....	10
Camera, process.....	1	Officers.....	1	<i>Photographic section</i>	
Press, rotary offset, large.....	2	Enlisted men.....	^b 49	Enlisted men.....	8
Press, rotary offset, medium.....	2	Pistol.....	50	Pistol.....	8
Carpenter set.....	1	<i>Lithographic platoon</i>		<i>Plate section</i>	
Drafting set.....	1	(Same as above.)		Enlisted men.....	8
Duplicating set.....	1	<i>Lithographic platoon</i>		Pistol.....	8
Electrician's set.....	1	(Same as above.)		<i>Press and finishing section</i>	
Pioneer set.....	1			Enlisted men.....	14
Pipe-fitting set.....	1			Pistol.....	14
Reproduction set, lithograph platoon..	1				
Sign-painting set.....	1				
Tinsmith set.....	1				
Pistol.....	192				

^a 6 privates are fillers and replacements.

^b 4 privates are fillers and replacements.

TABLE LII.—*Headquarters and service company, engineer battalion, water supply (T/O 5-66)*

<i>Headquarters and service company, water supply battalion</i>		<i>Company headquarters</i>		<i>Administrative section</i>	
Officers.....	2	Officers.....	2	Enlisted men.....	4
Enlisted men.....	80	Enlisted men.....	^a 14	Pistol, cal. .45.....	2
Car, 5-passenger sedan.....	1	Pistol, cal. .45.....	9	Rifle.....	2
Motorcycle, with side car.....	1	Rifle.....	7		
Trailer, 1-ton, cargo.....	1			<i>Operations section</i>	
Truck, 2½-ton, cargo.....	3	<i>Headquarters platoon</i>		Enlisted men.....	5
Truck, ½-ton, pick-up.....	2	Enlisted men.....	^b 15	Pistol, cal. .45.....	4
Water purification unit, mobile.....	6	Pistol, cal. .45.....	7	Rifle.....	1
Drafting set.....	1	Rifle.....	8		
Pipe-fitting set.....	1			<i>Supply section</i>	
Sign-painting set.....	1	<i>Service platoon</i>		Enlisted men.....	^b 6
Sketching set.....	2	Enlisted men.....	^c 51	Pistol, cal. .45.....	1
Supplementary set.....	1	Motorcycle, with side car.....	1	Rifle.....	5
Tinsmith set.....	1	Trailer, 1-ton, cargo.....	1		
Water supply set.....	1	Truck, 2½-ton, cargo.....	3	<i>Platoon headquarters</i>	
Blacksmith set (Q).....	1	Car, 5-passenger sedan.....	1	Enlisted men.....	^a 15
Carpenter and wheelwright set (Q).....	1	Truck, ½-ton, pick-up.....	2	Pistol, cal. .45.....	1
Pistol, cal. .45.....	26	Water purification unit, mobile.....	6	Rifle.....	14
Rifle.....	56	Pistol, cal. .45.....	10	<i>Transportation section</i>	
		Rifle.....	41	Enlisted men.....	^a 10
				Truck, ½-ton pick-up.....	2
				Motorcycle, with side car.....	1
				Trailer, 1-ton cargo.....	1
				Truck, 2½-ton, cargo.....	3
				Car, 5-passenger sedan.....	1
				Pistol, cal. .45.....	3
				Rifle.....	7
				<i>Purification section</i>	
				Enlisted men.....	^b 26
				Water purification unit, mobile.....	6
				Pistol, cal. .45.....	6
				Rifle.....	20

^a 1 private is filler and replacement.

^b 2 privates are fillers and replacements.

^c 4 privates are fillers and replacements.

TABLE LIII.—Company, water supply battalion (T/O 5-67)

		<i>Company headquarters</i>	
		Officers.....	1
		Enlisted men.....	^a 25
		Motorcycle, solo.....	1
		Truck, 2½-ton, cargo.....	3
		Truck, ½-ton, pick-up.....	1
		Trailer, 1-ton, cargo.....	1
		Pistol, cal. .45.....	9
		Rifle.....	17
		<i>Transportation platoon</i>	
		Officers.....	1
		Enlisted men.....	^b 23
		Truck, 2½-ton, tank, 750-gallon.....	12
		Truck, ½-ton, pick-up.....	1
		Pistol, cal. .45.....	5
		Rifle.....	19
		<i>Transportation platoon</i>	
		(Same as above.)	
		<i>Service platoon</i>	
		Officers.....	1
		Enlisted men.....	^a 38
		Truck, 2½-ton, tank, 750-gallon.....	6
		Truck, ½-ton, pick-up.....	1
		Water purification unit, mobile.....	1
		Pistol, cal. .45.....	5
		Rifle.....	34
		<i>Platoon headquarters</i>	
		Officers.....	1
		Enlisted men.....	^b 4
		Truck, ½-ton, pick-up.....	1
		Pistol, cal. .45.....	3
		Rifle.....	2
		<i>2 Tank truck sections</i>	
		Enlisted men.....	19
		Truck, 2½-ton, tank, 750-gallon.....	12
		Pistol, cal. .45.....	2
		Rifle.....	17
		<i>Platoon headquarters</i>	
		Officers.....	1
		Enlisted men.....	^c 4
		Truck, ½-ton, pick-up.....	1
		Pistol, cal. .45.....	2
		Rifle.....	3
		<i>Tank truck section</i>	
		Enlisted men.....	10
		Truck, 2½-ton, tank, 750-gallon.....	6
		Pistol, cal. .45.....	1
		Rifle.....	9
		<i>Purification section</i>	
		Enlisted men.....	^b 7
		Water purification unit, mobile.....	1
		Pistol, cal. .45.....	1
		Rifle.....	6
		<i>Installation section</i>	
		Enlisted men.....	^b 17
		Pistol, cal. .45.....	1
		Rifle.....	16

^a 4 privates are fillers and replacements.^b 1 private is filler and replacement.^c 2 privates are fillers and replacements.

TABLE LIV.—*Engineer company, depot (T/O 5-47)*

<i>Engineer company depot</i>		<i>Headquarters platoon</i>	<i>Company headquarters section</i>
Officers.....	4	Officers.....	1
Enlisted men.....	^a 174	Enlisted men.....	^b 57
Motorcycle.....	1	Motorcycle, solo.....	1
Trailer, 1-ton, cargo..	1	Trailer, 1-ton, cargo..	1
Truck, 1½-ton, cargo..	3	Truck, 1½-ton, cargo..	3
Truck, ½-ton, pick-up..	3	Truck, ½-ton, pick-up..	3
Pistol.....	28	Pipe-fitting set.....	1
Rifle.....	150	Sign-painting set.....	1
		Tinsmith set.....	1
		Blacksmith set (Q)...	1
		Carpenter and wheelwright set (Q).....	1
		Pistol.....	13
		Rifle.....	45
		<i>Depot platoon</i>	
		Officers.....	1
		Enlisted men.....	^b 39
		Pistol.....	5
		Rifle.....	35
		<i>Depot platoon</i>	
		(Same as above.)	
		<i>Depot platoon</i>	
		(Same as above.)	
		<i>Platoon headquarters section</i>	
		Lieutenant (platoon commander).....	1
		Enlisted men.....	^c 4
		Pistol.....	3
		Rifle.....	2
		<i>Depot section</i>	
		Enlisted men.....	^d 35
		Pistol.....	2
		Rifle.....	33

^a 16 privates are fillers and replacements.

^b 4 privates are fillers and replacements.

^c 1 private is filler and replacement.

^d 3 privates are fillers and replacements.

TABLE LV.—*Engineer company, mobile shop (T/O 5-157)*

<i>Engineer company, mobile shop</i>	<i>Headquarters platoon</i>		<i>Company headquarters section</i>	
	Officers.....	2	Officers.....	1
Enlisted men.....	Enlisted men.....	26	Enlisted men.....	* 17
Trailer, 1-ton, cargo....	Trailer, 1-ton, cargo....	2	Trailer, 1-ton, cargo....	2
Truck, ½-ton, com- mand.....	Truck, ½-ton, com- mand.....	1	Truck, ½-ton, com- mand.....	1
Truck, ½-ton, pick- up.....	Truck, ½-ton, pick- up.....	3	Truck, ½-ton, pick- up.....	1
Truck, 2½-ton, cargo....	Truck, 2½-ton, cargo....	1	Truck, 2½-ton, cargo....	1
Pistol, cal. .45.....	Pistol, cal. .45.....	14	Pistol, cal. .45.....	10
Rifle.....	Rifle.....	14	Rifle.....	8
			<i>Supply section</i>	
			Officers.....	1
			Enlisted men.....	4
			Truck, ½-ton, pick- up.....	1
			Pistol, cal. .45.....	2
			Rifle.....	3
			<i>Technical section</i>	
			Enlisted men.....	5
			Truck, ½-ton, pick- up.....	1
			Pistol, cal. .45.....	2
			Rifle.....	3
			<i>Platoon headquarters</i>	
			Officers.....	1
			Enlisted men.....	5
			Trailer, 1-ton, cargo....	1
			Truck, ½-ton, pick- up.....	1
			Truck, 2½-ton, cargo....	1
			Pistol, cal. .45.....	3
			Rifle.....	3
			<i>Mobile shop platoon</i>	
			Officers.....	1
			Enlisted men.....	48
			Truck, emergency re- pair.....	1
			Trailer, 1-ton, cargo....	3
Officers.....	5			
Enlisted men.....	170			
Truck, emergency re- pair.....	3			
Trailer, 1-ton, cargo....	11			
Truck, ½-ton com- mand.....	1			
Truck, ½-ton, pick- up.....	6			
Truck, 2½-ton, cargo....	13			
Truck, 2½-ton, cargo, with winch.....	3			
Truck, 2½-ton, wreck- er.....	3			
B & W printing set....	1			
Blacksmith set.....	1			
Blacksmith set (Q)....	1			
Canvas worker's set....	1			
Carpenter set.....	1			
Carpenter and wheel- wright set (Q).....	1			

* 1 private is a filler and replacement.

Drafting set.....	1	Truck, ½-ton, pick-		<i>Repair section</i>	
Pipe-fitting set.....	1	up.....	1	Enlisted men.....	^b 39
Sign-painting set.....	1	Truck, 2½-ton, cargo.	4	Trailer, 1-ton, cargo....	2
Tinsmith set.....	1	Truck, 2½-ton, cargo,		Truck, 2½-ton, cargo.	^c 3
Pistol, cal. .45.....	32	with winch.....	1	Truck, 2½-ton, cargo,	
Rifle.....	143	Truck, 2½-ton, wreck-		with winch.....	^d 1
		er.....	1	Pistol, cal. .45.....	2
		Pistol, cal. .45.....	6	Rifle.....	37
		Rifle.....	43		
		<i>Mobile shop platoon</i>		<i>Emergency repair section</i>	
		(Same as above.)		Enlisted men.....	4
		<i>Mobile shop platoon</i>		Truck, emergency, re-	
		(Same as above.)		pair.....	1
				Truck, 2½-ton, wreck-	
				er.....	1
				Pistol, cal. .45.....	1
				Rifle.....	3

^b 5 privates are fillers and replacements.

^c 1 tool and bench.

1 machine shop.

1 spare parts.

^d Welding truck.

TABLE LVI.—*Engineer company, dump truck (T/O 5-88)*

			<i>Company headquarters</i>	
			Officers.....	2
			Enlisted men.....	* 19
			Trailer, 1-ton.....	1
			Truck, 2½-ton, cargo.....	1
			Truck, ½-ton, pick-up.....	3
			Pistol.....	10
			Rifle.....	11
			<i>Dump truck section</i>	
			Enlisted men.....	† 20
			Truck, 1½-ton, dump.....	9
			Pistol.....	1
			Rifle.....	19
			<i>Headquarters section</i>	
			Officers.....	1
			Enlisted men.....	2
			Pistol.....	2
			Rifle.....	1
			<i>2 dump truck sections</i>	
			Enlisted men.....	* 39
			Truck, 1½-ton, dump.....	18
			Pistol.....	2
			Rifle.....	37
			<i>Headquarters platoon</i>	
			Officers.....	2
			Enlisted men.....	39
			Trailer, 1-ton.....	1
			Truck, 2½-ton, cargo.....	1
			Truck, 1½-ton, dump.....	9
			Truck, ½-ton, pick-up.....	3
			Carpenter and wheelwright set (Q).....	1
			Pistol.....	11
			Rifle.....	30
			<i>Transportation platoon</i>	
			Officers.....	1
			Enlisted men.....	41
			Truck, 1½-ton, dump.....	18
			Pistol.....	4
			Rifle.....	38
			<i>Transportation platoon</i>	
			(Same as above.)	
<i>Engineer company, dump truck</i>				
Officers.....	4			
Enlisted men.....	121			
Trailer, 1-ton.....	1			
Truck, 2½-ton, cargo.....	1			
Truck, 1½-ton, dump.....	45			
Truck, ½-ton, pick-up.....	3			
Pistol.....	19			
Rifle.....	106			

* 1 private is filler and replacement.

† 2 privates are fillers and replacements.

* 8 privates are fillers and replacements.

APPENDIX III
CHECK LISTS

■ 1. CHECK LIST FOR AN ENGINEER ORAL ORDER.

FO———

Maps:

1. Information of enemy———
Information of own troops, higher, lower, adjacent, and covering forces. What our unit is now doing. You know situation. (Get situation from S-2/3 map, or staff officer.)
2. This (plat, co, bn) will (attack, defend, withdraw, assist) at —— AM (today, tomorrow, or date) by (enveloping, organizing and defending, repairing) the (location from —— to ——). For-
mation: ——
Boundaries, LD, MLR, or route; see map (if any).
3. Missions for subordinate units:
A will ——
B will ——
C will ——
Hq will ——
Special instructions applicable to all units.
4. Ammunition dumps at ——
Engr dumps at ——
Aid station at ——
Meals distributed —— (how) —— (where) ——
(time) ——
5. CPs: Subordinate units ——
Supporting units ——
Own hq (or I will be at —— until —— PM, thereafter at ——).
Set your watches. It is now —— AM (PM).
Any questions?

■ 2. CHECK LIST FOR ISSUING ORDERS.

1. *Estimate of the situation* upon the receipt of orders, warn-
ing orders, or other indications of a proposed opera-

tion, resulting in a definite decision announced by the unit commander.

2. *Early issue of a directive* to staff covering essential elements of proposed operation for executing and decision.
3. *Coordination by the executive* of work of each of several staff sections both within each section and between sections to see that all salient features of the commander's directive are covered.
4. *Proper staff team play and coordination* within and between staff sections and with other staffs and units concerned.
5. *Warning orders* issued early to units to allow time for necessary plans, reconnaissances, and preparations.
6. *Development of flexible plans* kept up to date, progressive, and adaptable to changes in orders or situation.
7. *Brief and clear orders* written by the staff receive final action and approval by the commander. Issuance and distribution must be made in time to be of use. If action is already executed through fragmentary orders, these are promptly consolidated into a formal order and issued for record.

■ 3. CHECK LIST FOR PLANS OF ENGINEER UNITS AND UNIT ENGINEERS.

1. Information to be obtained by a unit engineer before formulation of plans for the engineer operations of his unit:
 - a. Plan for tactical employment of the command served.
 - b. Administrative orders and/or approved plans of higher units.
 - c. Administrative decisions of unit commander and/or G-4.
 - d. Tentative plans of other arms and services.
 - e. Engineer strength and situation reports covering terrain and weather, number and condition of own troops, equipment, materials, transportation, and reinforcements available.
2. Engineer needs:
 - a. Requirements of materials, essentials vs. useful items.

- b. Troops, transport, and equipment.
- c. Engineer depots, number and location.
- 3. Engineer supplies, on hand, procurable, and credits.
- 4. Engineer units:
 - a. Assignment of units to tasks, or to higher or lower echelons.
 - b. Reconnaissances and inspection reports.
 - c. Authority for location of headquarters of engineer units.
 - d. Means of signal communication; message service.
- 5. Supply of engineer units:
 - a. Adequate supply is the responsibility of each unit commander and requires thorough staff planning and coordination.
 - b. Trains of engineer units operate as a pool of transportation to be used as the situation requires without regard to specific subordinate units.
 - c. Trains of engineer units, including prescribed loads, furnish a mobile and flexible system of supply.

■ 4. CHECK LIST OF REMINDERS FOR UNIT ENGINEERS.

- 1. a. Know the commander's general scheme of maneuver and nature of engineer work it requires.
- b. Know missions assigned to all our own and nearby engineer troops; if not known, be prepared to make requests or recommendations thereon based on most vital needs for engineer work.
- c. Know what distribution of engineer troop units on various tasks has been made, which jobs have too many or too few, which need more help and which can spare troops for other emergency work.
- 2. a. Conduct and report results of continual engineer reconnaissance.
- b. Require technical engineer reconnaissance and situation reports from lower units and summarize these periodically for reports to higher units.
- 3. Establish an engineer information service and issue bulletins.
- 4. Make continual estimates of effects of terrain and weather on capabilities of our own and enemy troops.

5. *a.* Know nature and location of all engineer materials, facilities, and utilities within our own and by liaison in adjacent areas.
- b.* Know amount of engineer tools and supplies available in your unit and amounts needed by subordinate units.
- c.* Know where higher engineer depots, etc., are located, routes thereto, and supplies, materials, and tools available therein.
6. Know details of traffic circulation plans and have in mind alternative routes in event vital routes are impassable.
7. Know what roads are to be maintained, rebuilt, or abandoned.
8. Have roads marked with signs for direction, danger points, units, MSR.
9. Locate best positions for engineer dumps in defensive situations.
10. Know the commander's plan for organization of the ground, general methods of defense to be employed, troops to occupy various positions, type and extent of organization work to be done; be prepared to make recommendations if this information is not ready.
11. *a.* Recommend to chief of staff division of engineer work to be assigned to engineers of own and subordinate units.
- b.* Maintain close liaison with engineers of lower, higher, and adjacent units, understand problems, and give help when possible.
12. Consider plans in anticipation of action other than that now engaged in. Have demolition and defensive position plans outlined during an advance. Plan for repair of essential roads and bridges across enemy positions during a defensive with an advance in view. Have sources and amounts of necessary materials and troops for these operations in mind.
13. Know types and amounts of maps that will be needed and have a supply on hand in anticipation of demand for them.

14. Know state of camouflage training of command; inspect and cooperate; furnish all available supply and help.
15. *a.* Maintain a close contact with situation and with all members of the general staff so as to know what engineer assistance will need to be given each staff section.
b. Keep staff advised of tactical and engineer situation and needs; have staff get help when needed.
16. Keep headquarters periodically informed of location and itinerary.

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